A330
TECHNICAL TRAINING MANUAL
MECHANICAL & AVIONICS COURSE - T1+T2 (LVL 2&3)
(RR Trent 700)
AUTO FLIGHT

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AUTO FLIGHT LINE MAINTENANCE BRIEFING (2)

GENERAL

This module describes the operational use of the Automatic Flight System (AFS) and the Flight Management Guidance and Envelope Computers (FMGECs) in a normal operation with total availability of the concerned functions. The short-term pilot orders are normally entered through the Flight Control Unit (FCU) while the long-term pilot orders are entered through the MCDUs. Four key words for the control principle and both types of guidance have to be kept in mind in order to avoid handling errors.

Aircraft control is:

- either automatic, that means AutoPilot (AP) or AutoTHRust (A/THR),
- or manual, that means pilot action on side sticks or thrust levers.

Aircraft guidance is:

- either managed, that means targets are provided by the Flight Management (FM) functional part,
- or selected, that means targets are selected by the pilots through the FCU.

POWER-UP TEST FD ENGAGEMENT

As soon as electrical power is available, the Flight Director (FD) is automatically engaged provided that the power-up test is successful. No FD guidance symbols are displayed on the EFIS PFDs until take- off.

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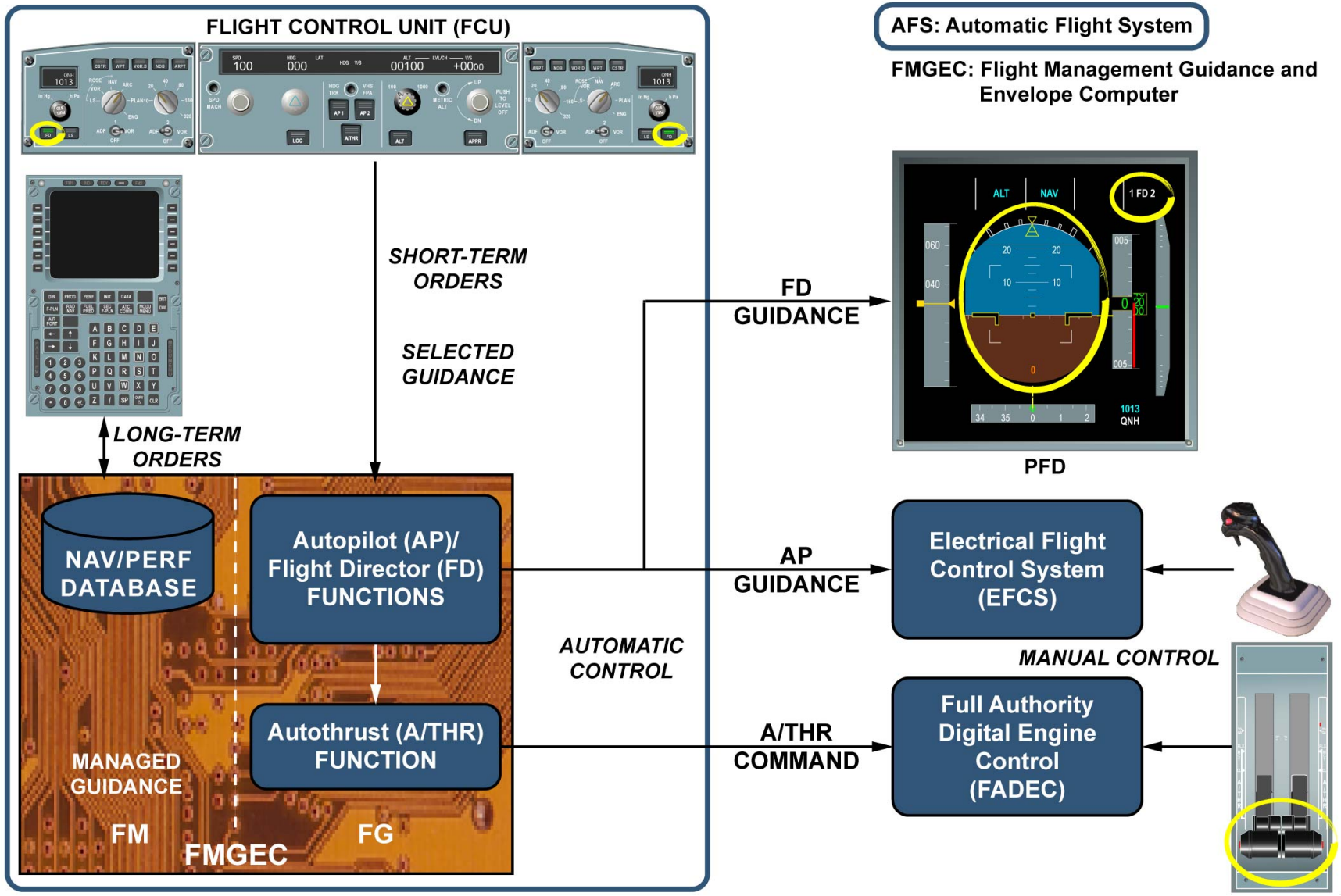

GENERAL & POWER-UP TEST FD ENGAGEMENT

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AUTO FLIGHT LINE MAINTENANCE BRIEFING (2)

MCDU INITIALIZATION

The pilots use the MCDU for flight preparation, which includes:
- choice of the data base,
- flight plan initialization,
- radio navigation entries and checks,
- performance data entry such as V1 (decision speed), VR (rotation speed), V2 (take-off reference speed) and FLEX TEMP (flexible temperature) and weights.

Entry of the flight plan (lateral and vertical) and V2 into the MCDU is taken into account by the FM part and confirmed by the lighting of the related lights on the FCU to indicate that the system is in managed mode.
An altitude also has to be selected through the FCU.

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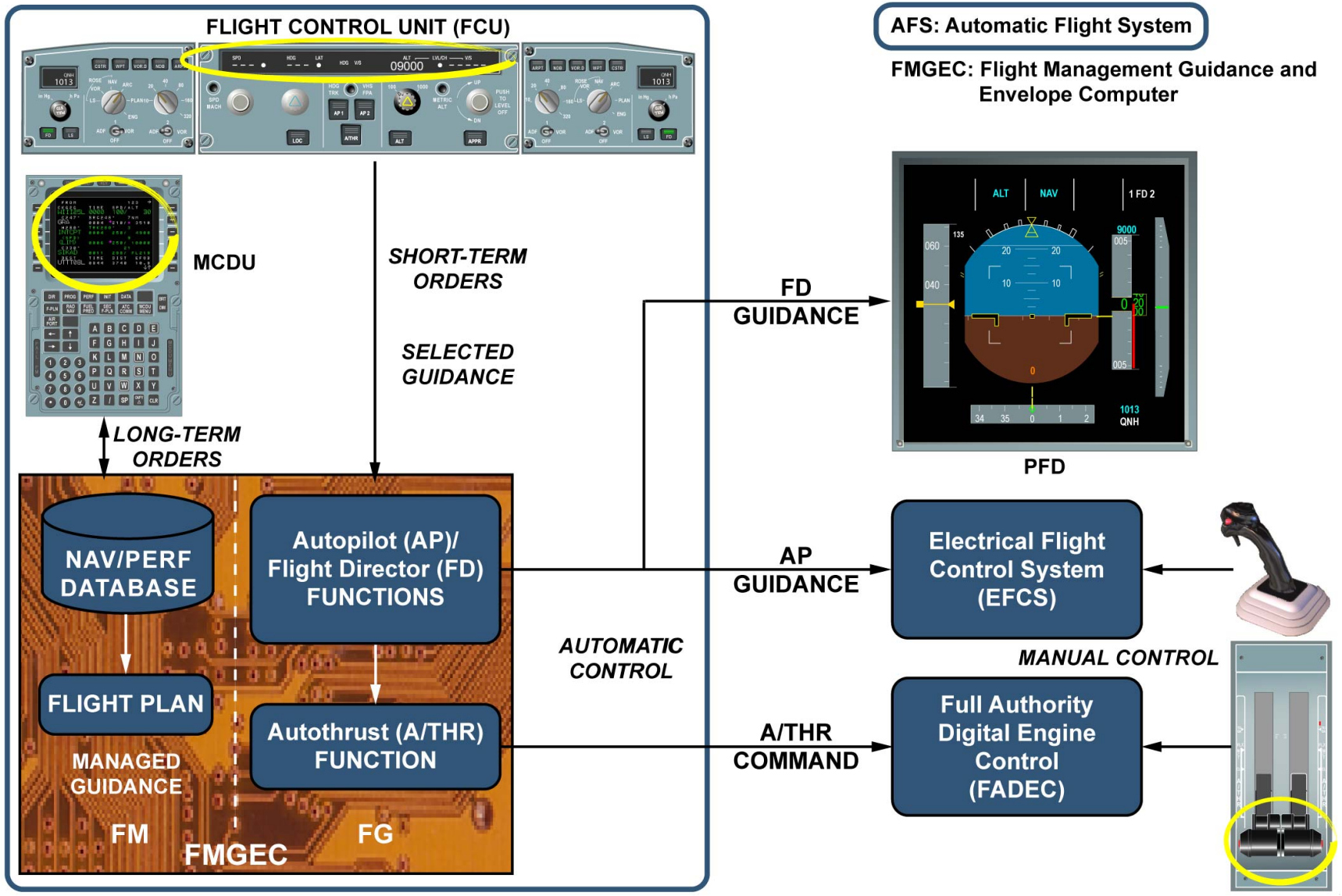

MCDU INITIALIZATION

AUTO FLIGHT LINE MAINTENANCE BRIEFING (2)

A/THR ENGAGEMENT

A/THR engagement depends on the position of the thrust levers for take-off. For take-off, the thrust levers are set to either the Take-Off/Go-Around (TO/GA) gate or the FLEXible-Maximum Continuous Thrust (FLEX-MCT) gate if a flexible temperature has been entered on the MCDU. When the pilot moves the thrust levers to the TO/GA gate, the FMGECs automatically engage the take-off operational modes for yaw and longitudinal guidance. The A/THR function is engaged (but it is not active) and the FD guidance symbols appear on the PFDs. At the thrust reduction altitude, the FM part warns the pilot to set the thrust levers to the CLimB gate.

NOTE: Note: The thrust levers will not normally leave this position until a RETARD audio message tells the pilots to set the thrust levers to the IDLE gate before touch-down.

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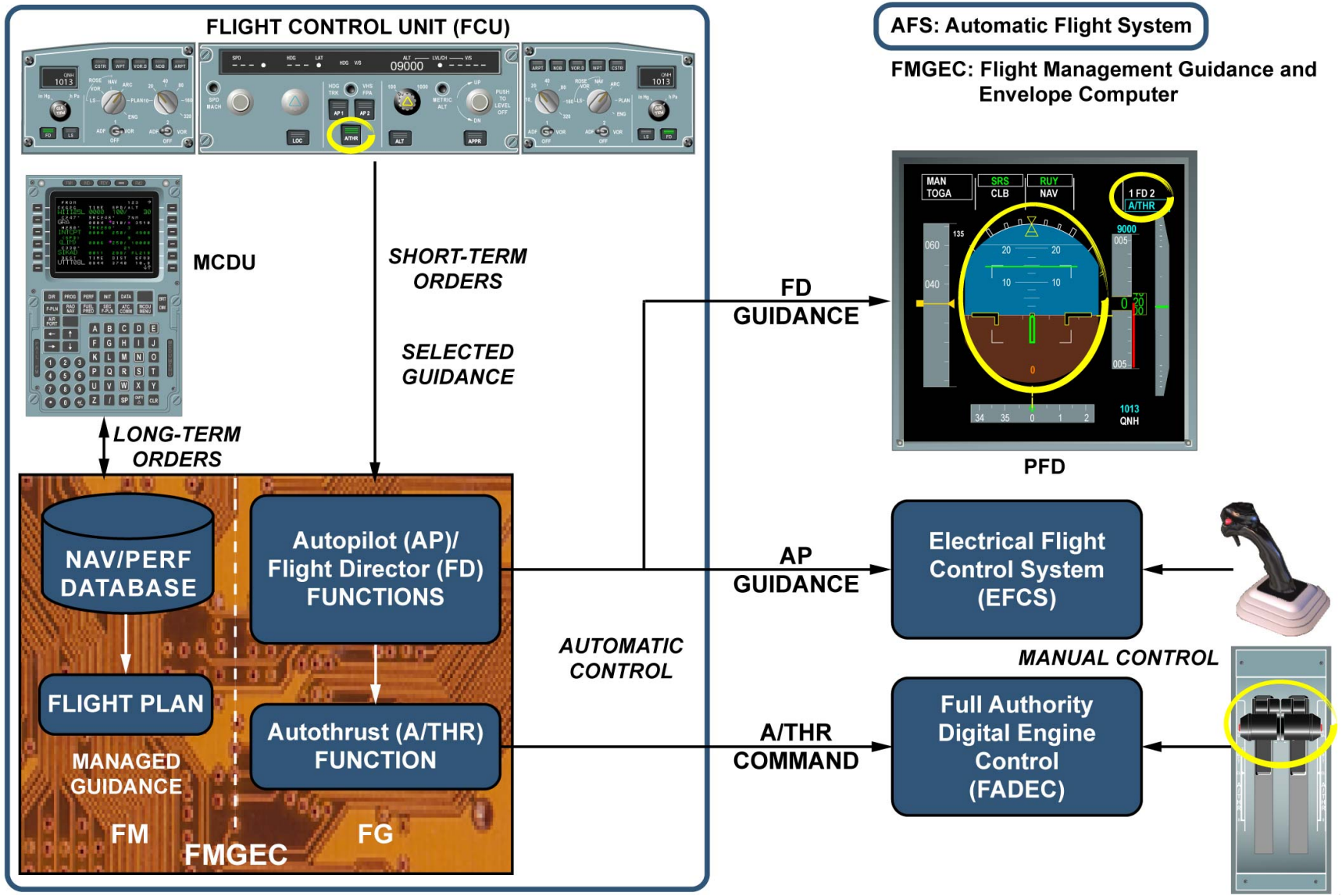

A/THR ENGAGEMENT

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AUTO FLIGHT LINE MAINTENANCE BRIEFING (2)

AP ENGAGEMENT

Either AP can only be engaged 5 seconds after lift-off. Only one AP can be engaged at a time, the last in being the last engaged. After the normal climb, cruise and descent phases, the selection of automatic landing through the APProach FCU P/B lets the second AP be engaged. After touch-down, during roll-out, APs remain engaged to control the aircraft on the runway centerline. The pilots disengage APs at low speed or when the A/C is stopped.

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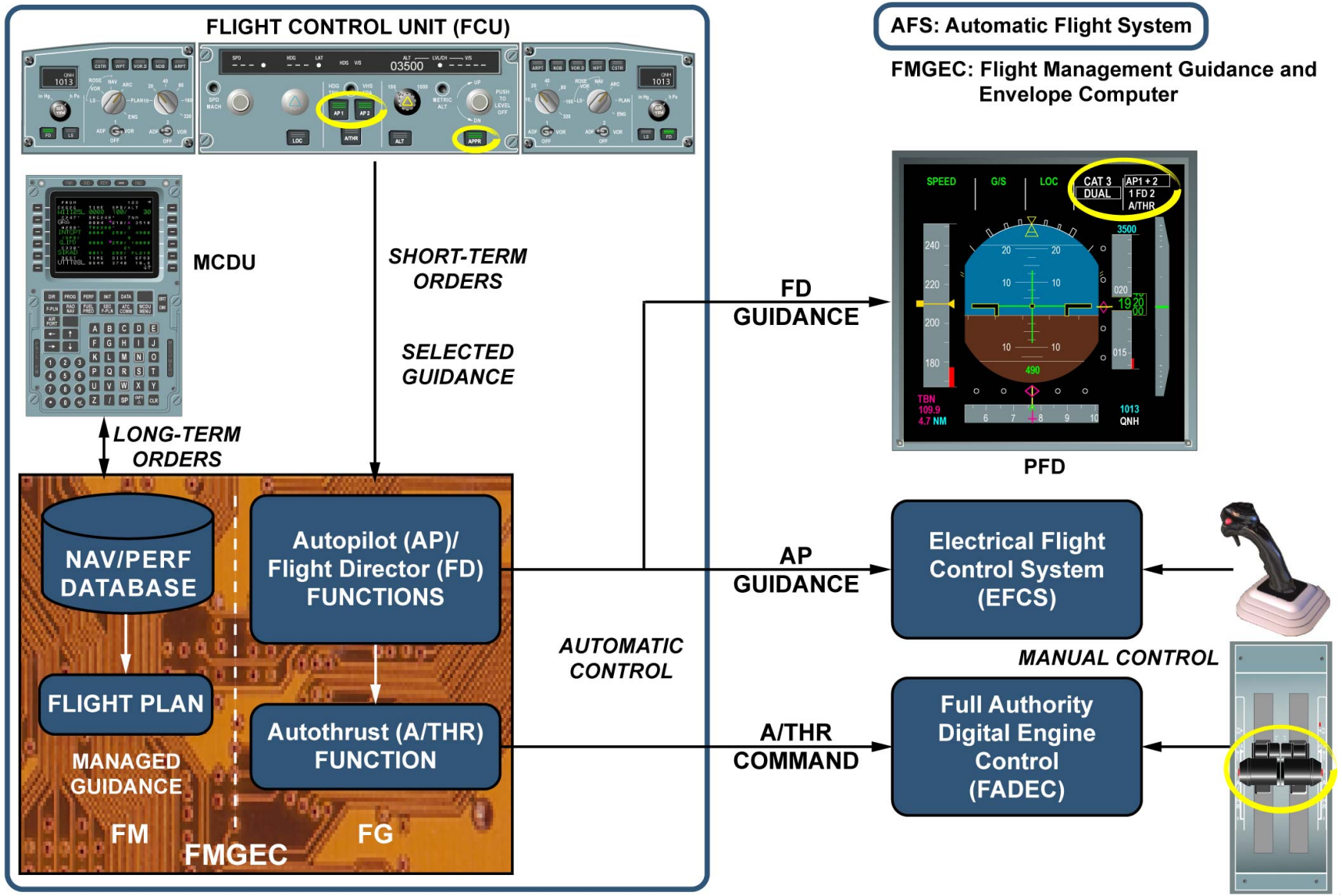

AP ENGAGEMENT

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AUTO FLIGHT LINE MAINTENANCE BRIEFING (2)

DATA BASE LOADING

The navigation and performance data base must be loaded and updated to keep the system operational. Only the navigation data base is periodically updated (every 28 days). This module gives information related to the uploading and crossloading of the elements of the FM part of the FMGECs. The uploading is done using the Multipurpose Disk Drive Unit (MDDU).
The FM part of each FMGEC operates thanks to:
- the Flight Management System (FMS) operational software,
- the PERFormance and NAVigation data bases aid,
- the OPerational control Configuration (OPC),
- and the Airline Modifiable Information (AMI) configuration files which are mandatory loadable elements.

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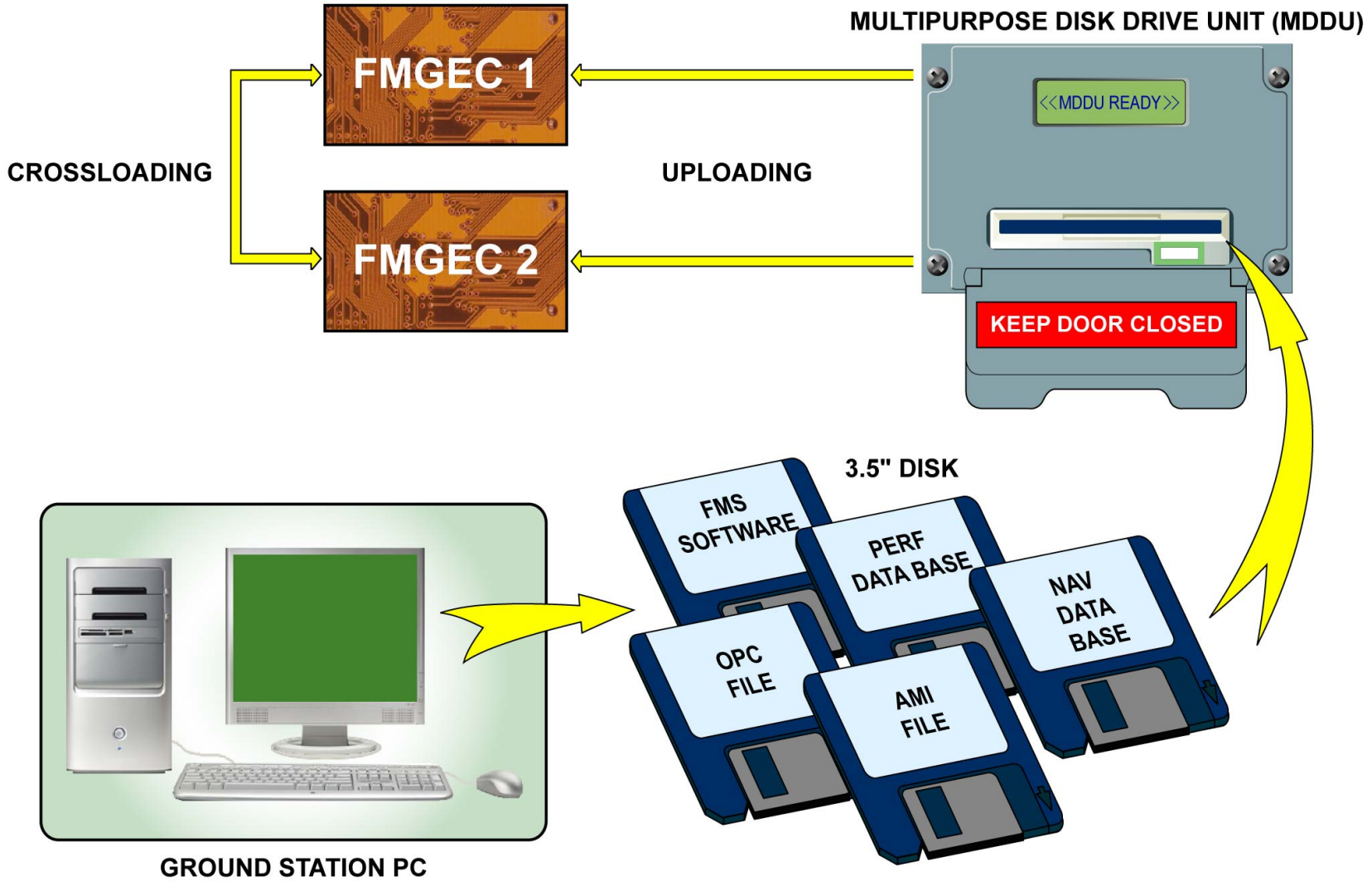

DATA BASE LOADING

AUTO FLIGHT LINE MAINTENANCE BRIEFING (2)

UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC

AIRCRAFT MAINTENANCE CONFIGURATION

Make sure that the FM source selector is in the NORM position.

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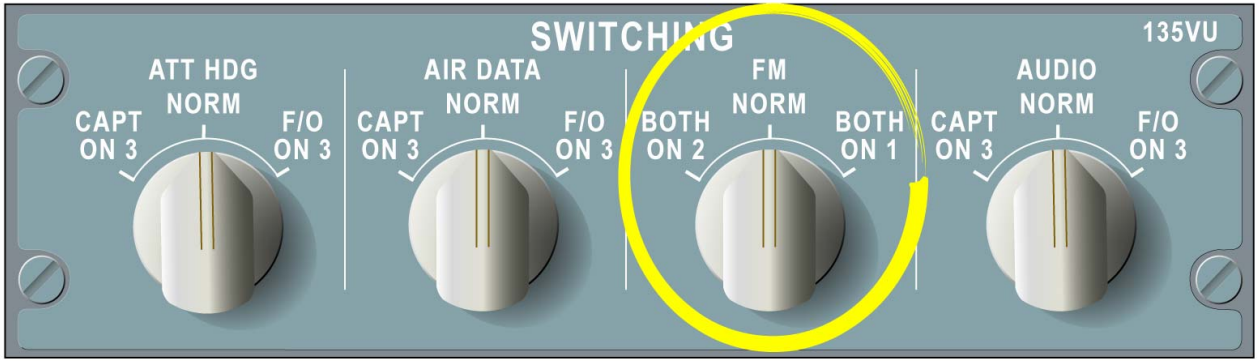
UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA OF THE FMGEC:

Aircraft maintenance configuration

On the panel 135VU, make sure that the SWITCHING/FM selector is in the NORM position.



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UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - AIRCRAFT MAINTENANCE CONFIGURATION

AUTO FLIGHT LINE MAINTENANCE BRIEFING (2)

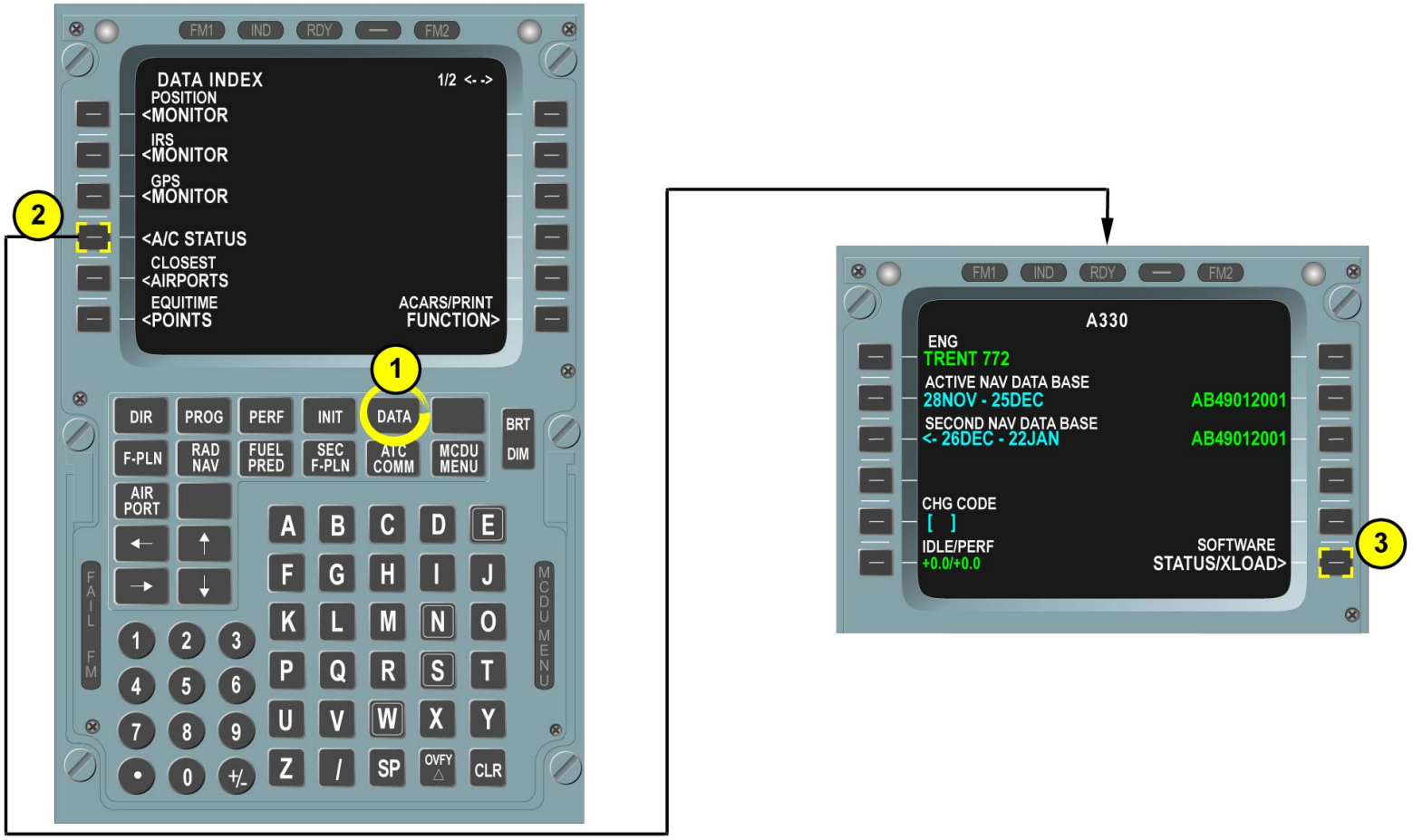
UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC (continued)

CHECK OF THE LOADABLE ELEMENTS P/N REFERENCE

The check of the P/N reference of the loadable elements is done through the applicable P/N STATUS page. Make sure that the software P/N reference, displayed on the related P/N STATUS page, is different from the P/N on the related floppy disk. To determine which elements need to be loaded: Push the DATA mode key on the MCDU and get access to the A/C STATUS page. Then select the SOFTWARE STATUS/XLOAD indication to display the P/N XLOAD page.
To get access to the FM operational software (page 2/6), push the line key adjacent to the NEXT PAGE of the page 1/6.
Make sure that the P/N reference is not the same as the P/N reference on the disk. Otherwise the uploading is not necessary.
Make sure that the P/N reference is not the same as the P/N reference on the disk. Otherwise the uploading is not necessary.

UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA OF THE FMGEC:

Check of the P/N reference status of the element(s) (pre-load in the related FMGEC



UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - CHECK OF THE LOADABLE ELEMENTS P/N REFERENCE

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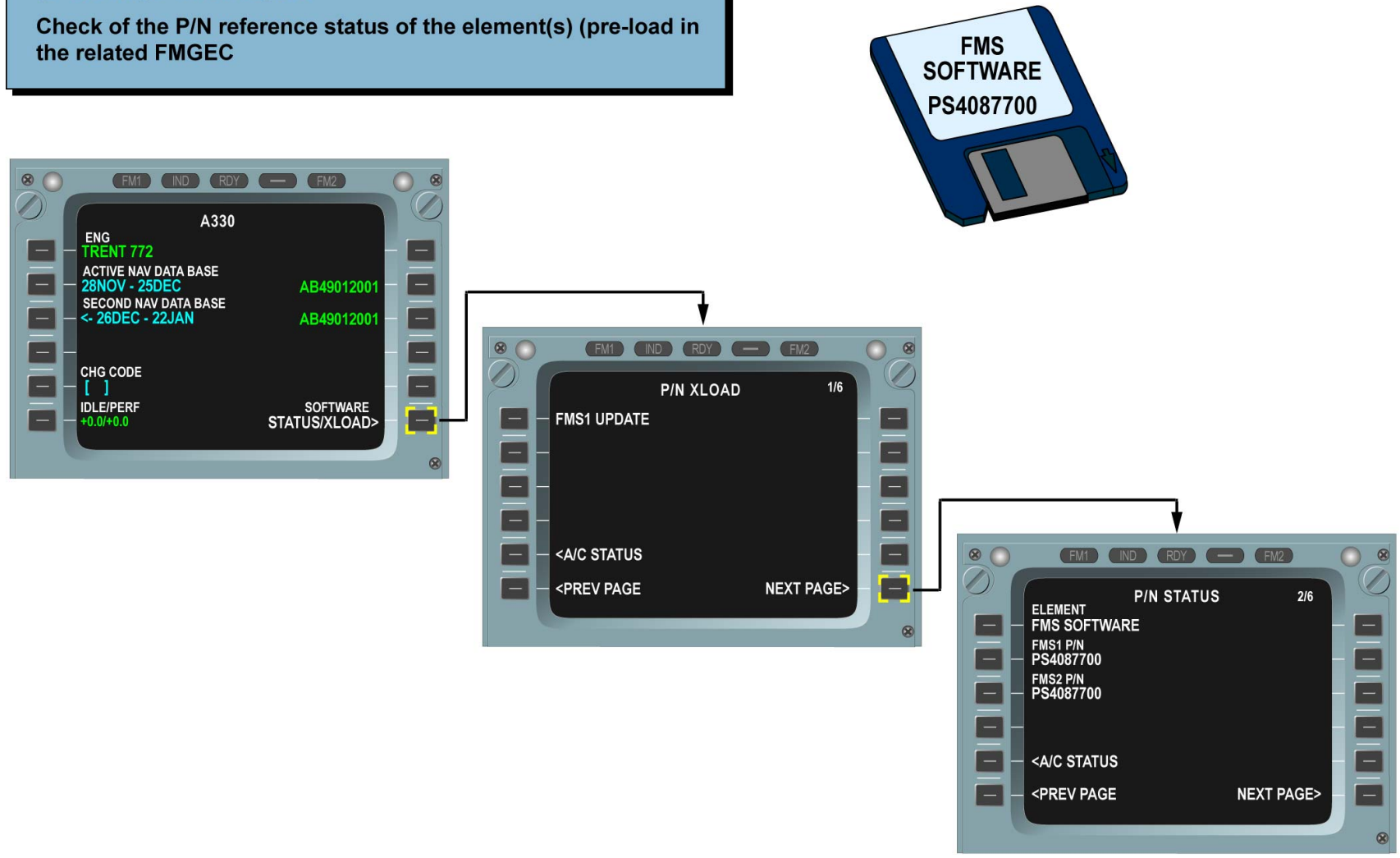
UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA OF THE FMGEC:

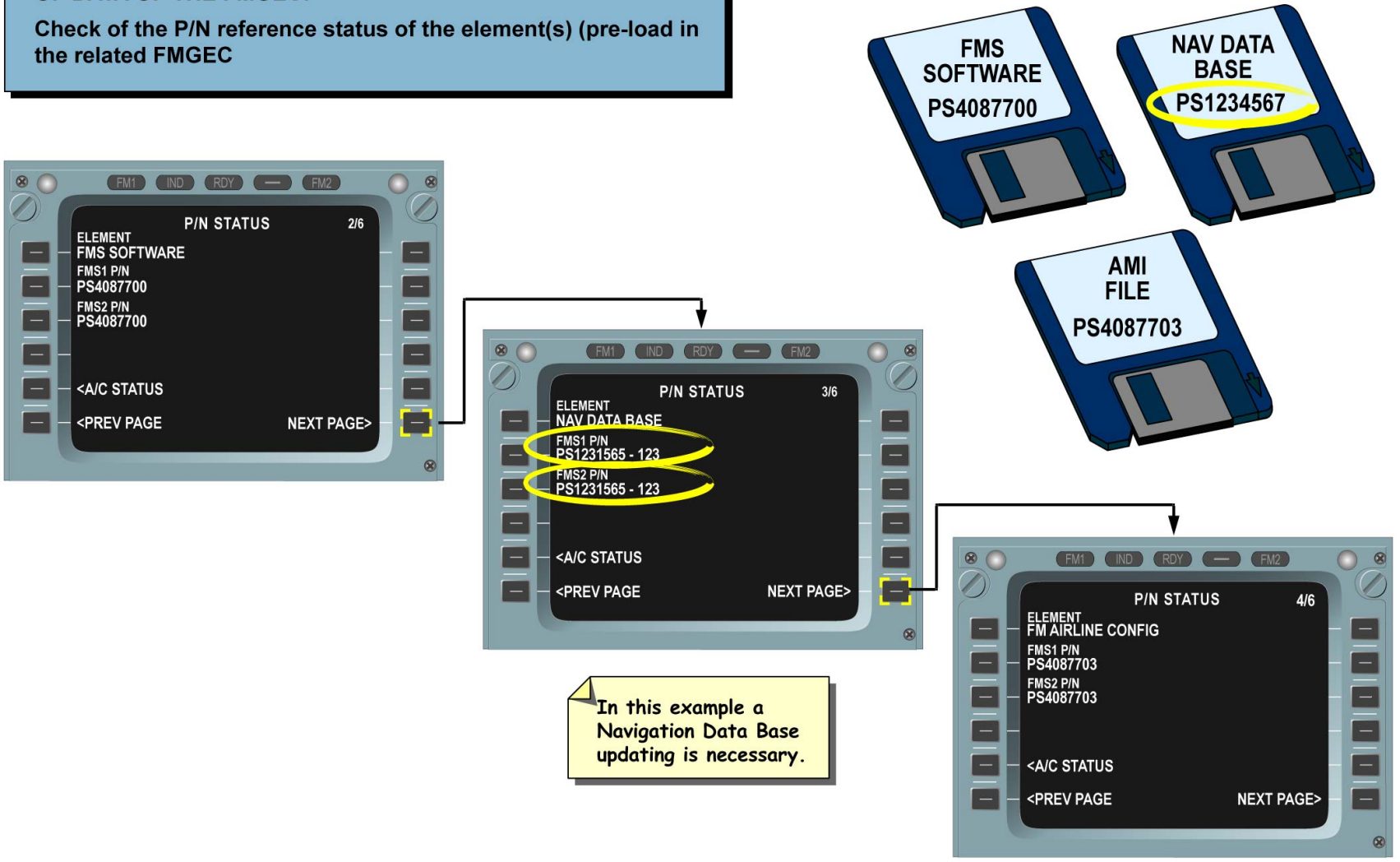
Check of the P/N reference status of the element(s) (pre-load in the related FMGEC



UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - CHECK OF THE LOADABLE ELEMENTS P/N REFERENCE

UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA OF THE FMGEC:

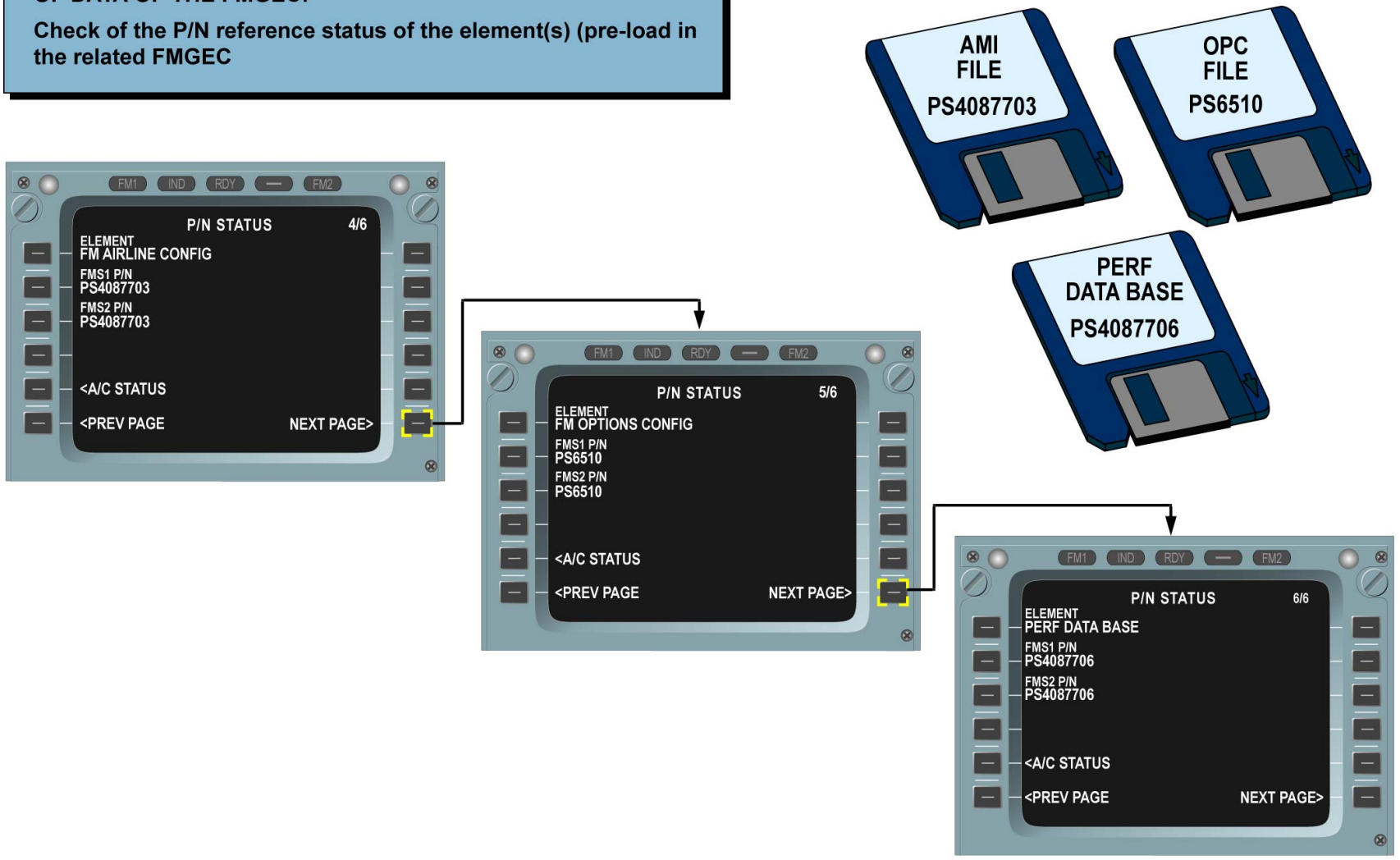
Check of the P/N reference status of the element(s) (pre-load in the related FMGEC



UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - CHECK OF THE LOADABLE ELEMENTS P/N REFERENCE

UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA OF THE FMGEC:

Check of the P/N reference status of the element(s) (pre-load in the related FMGEC



UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - CHECK OF THE LOADABLE ELEMENTS P/N REFERENCE

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AUTO FLIGHT LINE MAINTENANCE BRIEFING (2)

UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC (continued)

UPLOADING OF THE FMGEC

Open one of the two FMGECs C/Bs on the RESET panel. On the Data Loading Selector (DLS) select the applicable FMGEC.
Insert the applicable disk into the MDDU. Close the applicable FMGEC C/B. Monitor the data transfer and make a check on completion on the MDDU.
Remove the disk and deselect the FMGEC through the DLS. Reset the loaded FMGEC.
Check through the related P/N STATUS page that the displayed software P/N reference is identical to the P/N reference read on the relevant disk.

NOTE: When the FMGEC power-up is completed, and if the opposite FMGEC is not yet uploaded, the amber IND annunciator comes on both MCDUs, and the INDEPENDENT OPERATION indication appears on each MCDU scratchpad.

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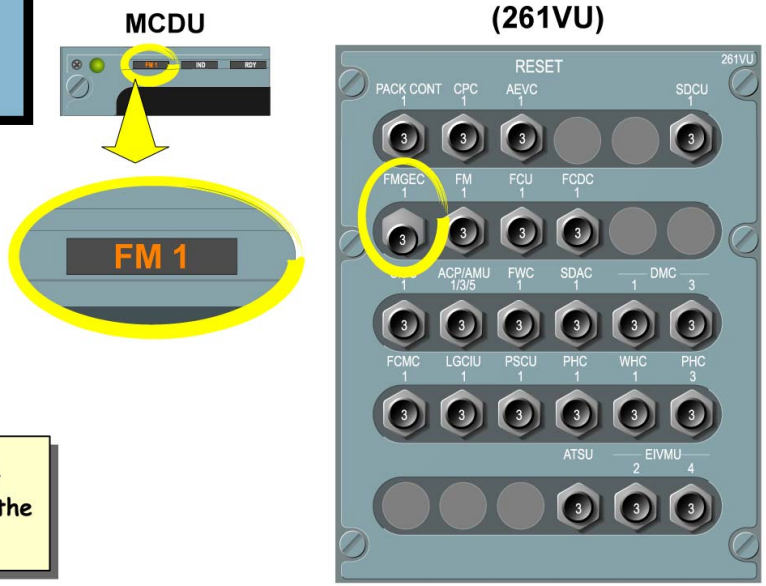
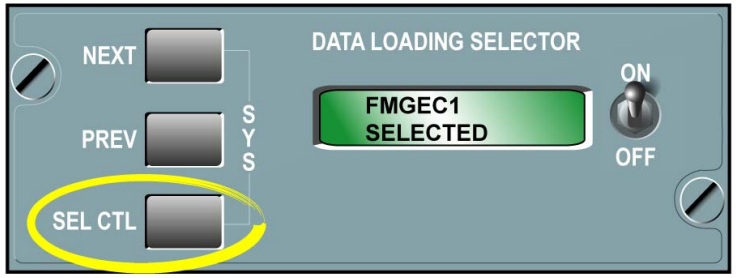
UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA OF THE FMGEC:

Uploading of the FMGEC

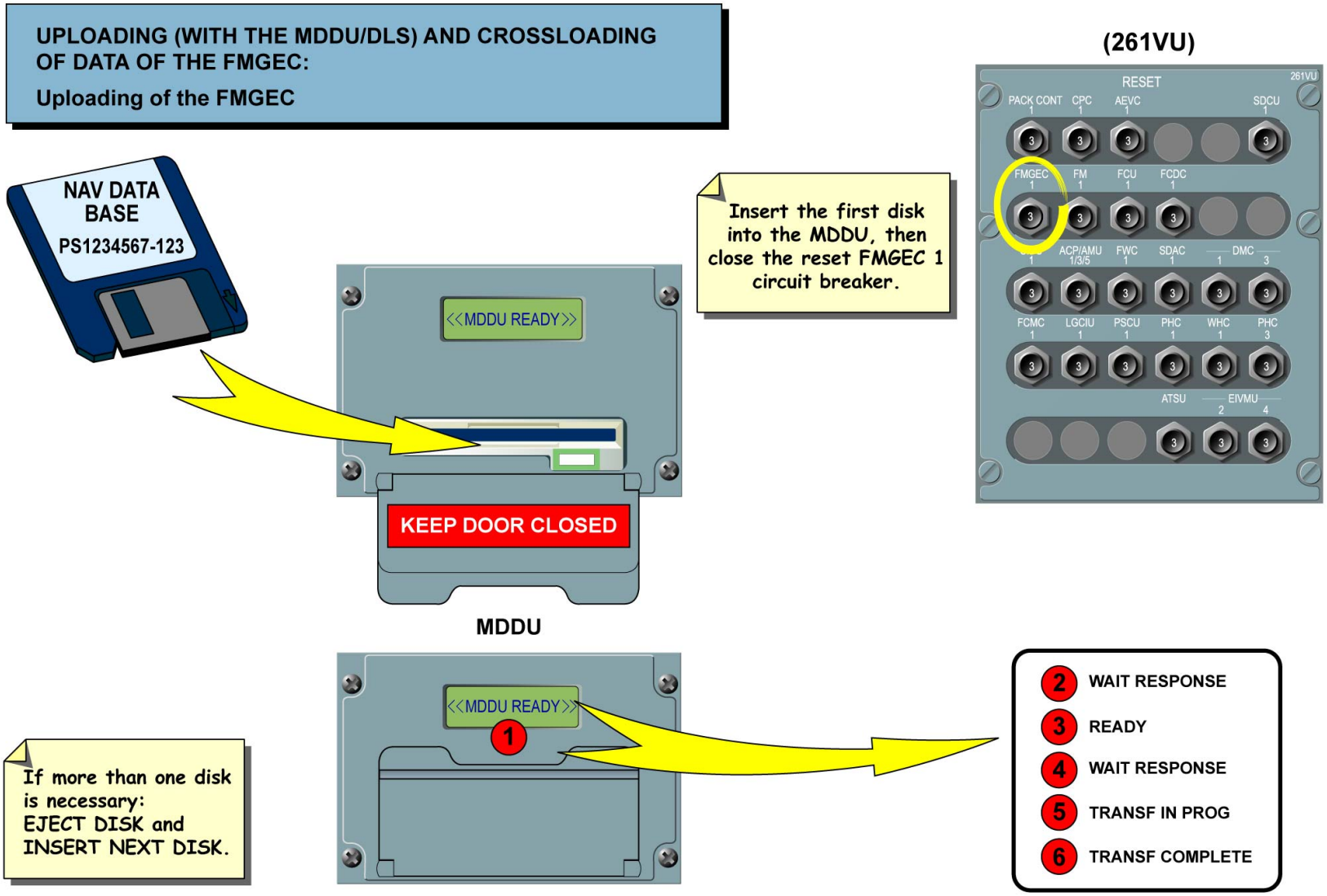


Open the reset FMGEC 1 circuit breaker and select FMGEC 1 with the Data Loading Selector (DLS).



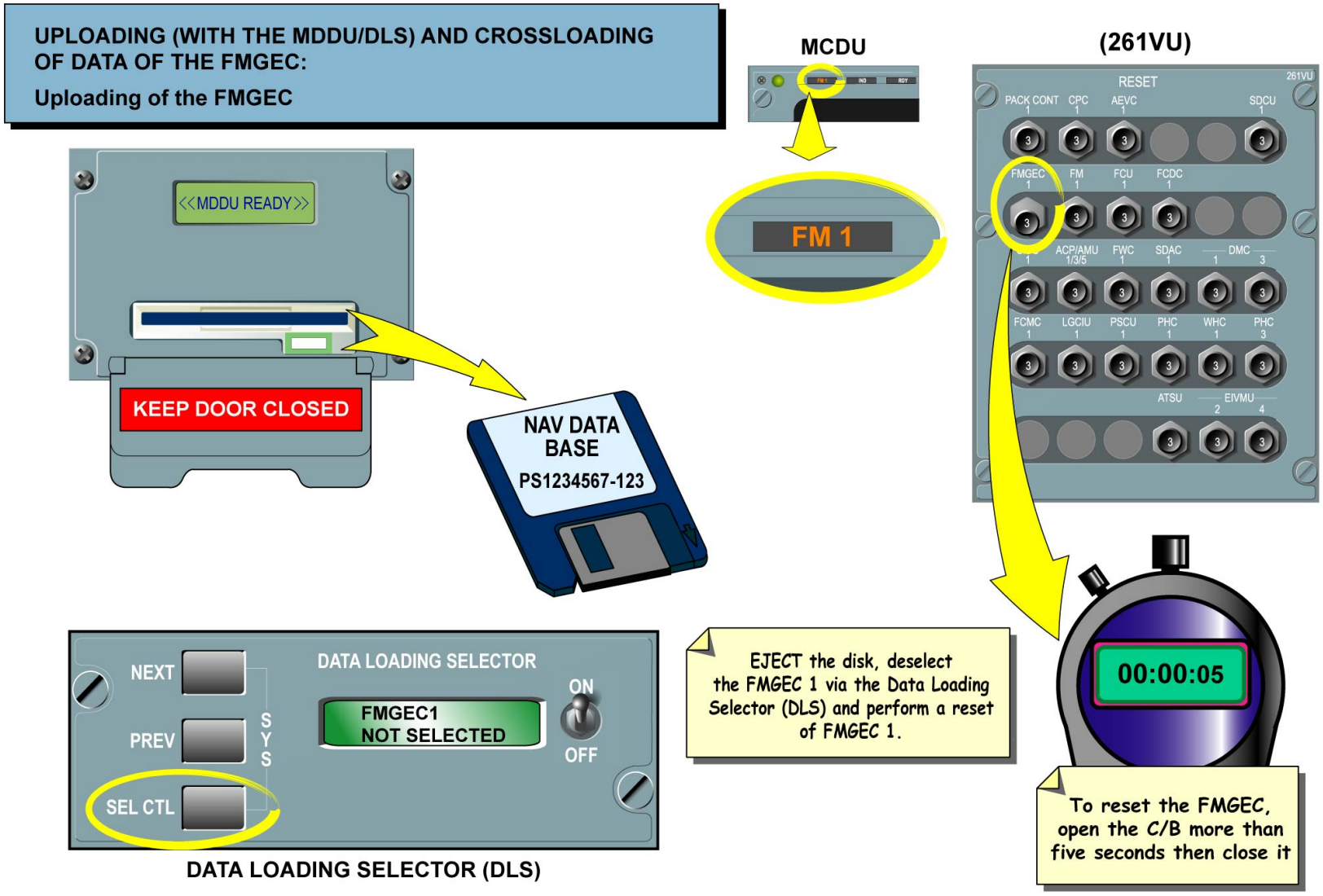
DATA LOADING SELECTOR (DLS)

UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - UPLOADING OF THE FMGEC



UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - UPLOADING OF THE FMGEC

G9409341 - GAUT0T0 - FM22B1000000001



UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - UPLOADING OF THE FMGEC

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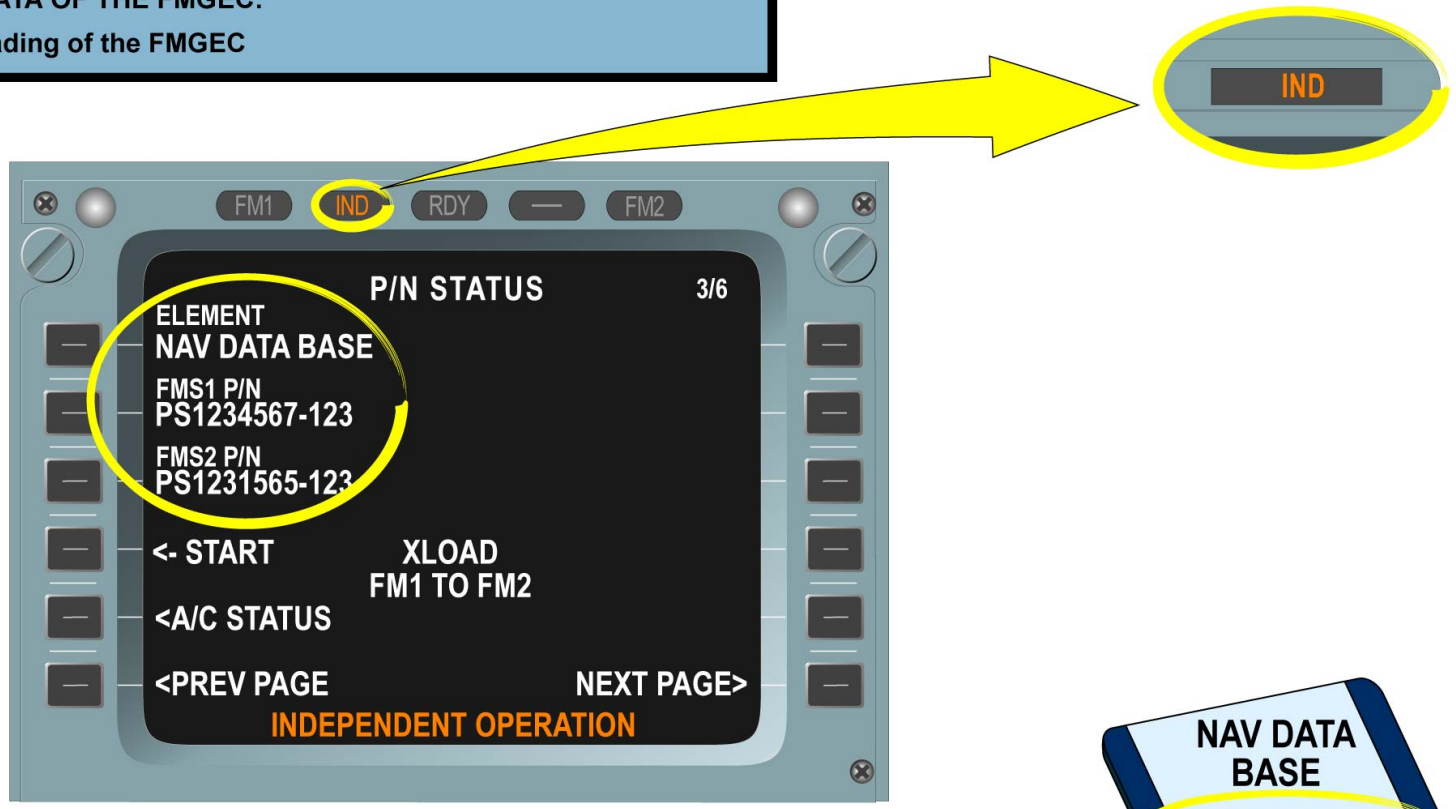
UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA OF THE FMGEC:

Uploading of the FMGEC



UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - UPLOADING OF THE FMGEC

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AUTO FLIGHT LINE MAINTENANCE BRIEFING (2)

UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC (continued)

CROSSLOADING PROCEDURE

When the uploading of the first FMGEC is completed, the XLOAD function can be used for the loading of the opposite FMGEC. In our example, we will XLOAD the FMGEC2 from the FMGEC1.
If all the elements have to be crossloaded, a Flight Management System (FMS) UPDATE can be done through the P/N XLOAD page. Otherwise, use the P/N STATUS page related to the element, which has to be crossloaded. In both cases, the crossloading will be done from the MCDU related to the FMGEC already uploaded (MCDU 1 in our example). On the applicable P/N STATUS page, make sure that FMS1 and FMS2 have different P/Ns. Push the START XLOAD key to activate the loadable elements compatibility check. Then confirm your selection to activate the crossloading process.
When the crossloading is completed, reset the loaded FMGEC. Make sure that both FMGECs are no longer in independent mode operation. The amber IND annunciator and the INDEPENDENT OPERATION indication go off. Check through the related P/N STATUS page that the displayed software P/N reference is identical to the P/N reference read on the relevant disk. The procedure is now completed; you know how to upload and crossload data from a disk to the FMGEC, via the MDDU, the DLS and the MCDU.

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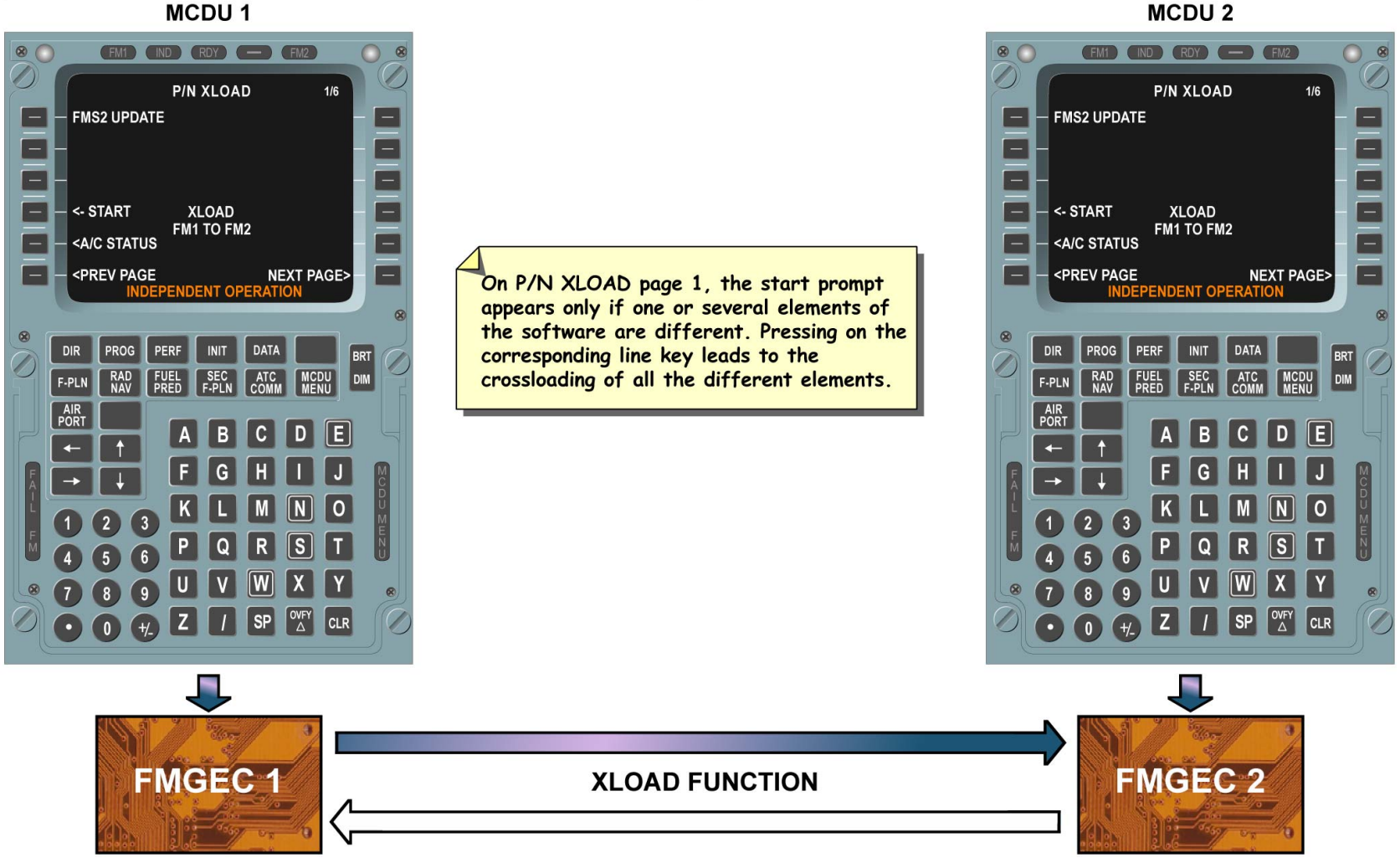
UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA OF THE FMGEC:


MCDU 1
MCDU 2
P/N XLOAD 1/6
FMS2 UPDATE
<- START
XLOAD
FM1 TO FM2
<A/C STATUS
<PREV PAGE
NEXT PAGE>
INDEPENDENT OPERATION
On P/N XLOAD page 1, the start prompt appears only if one or several elements of the software are different. Pressing on the corresponding line key leads to the crossloading of all the different elements.
FMGEC 1
XLOAD FUNCTION
FMGEC 2

UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - CROSSLOADING PROCEDURE

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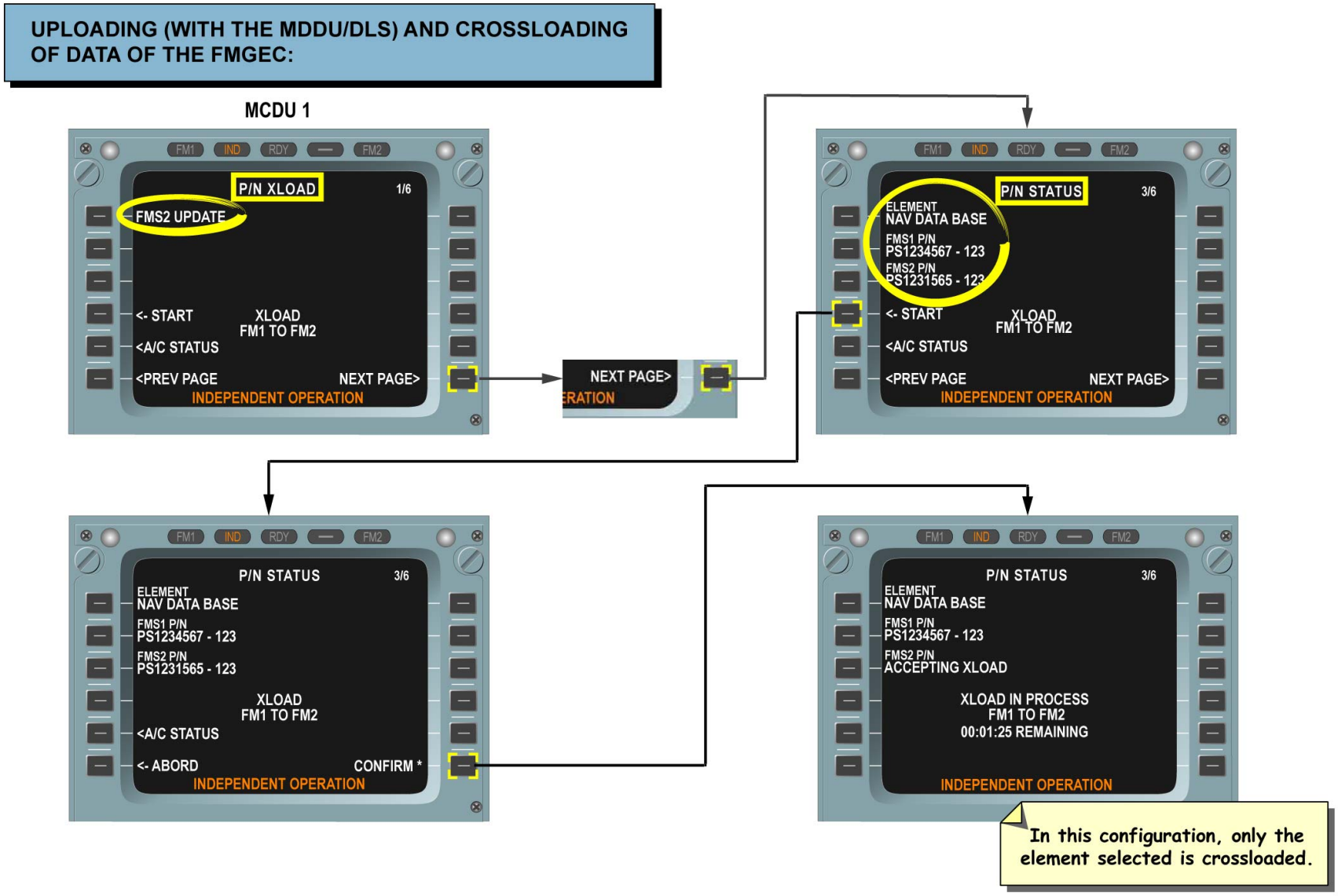

UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - CROSSLOADING PROCEDURE

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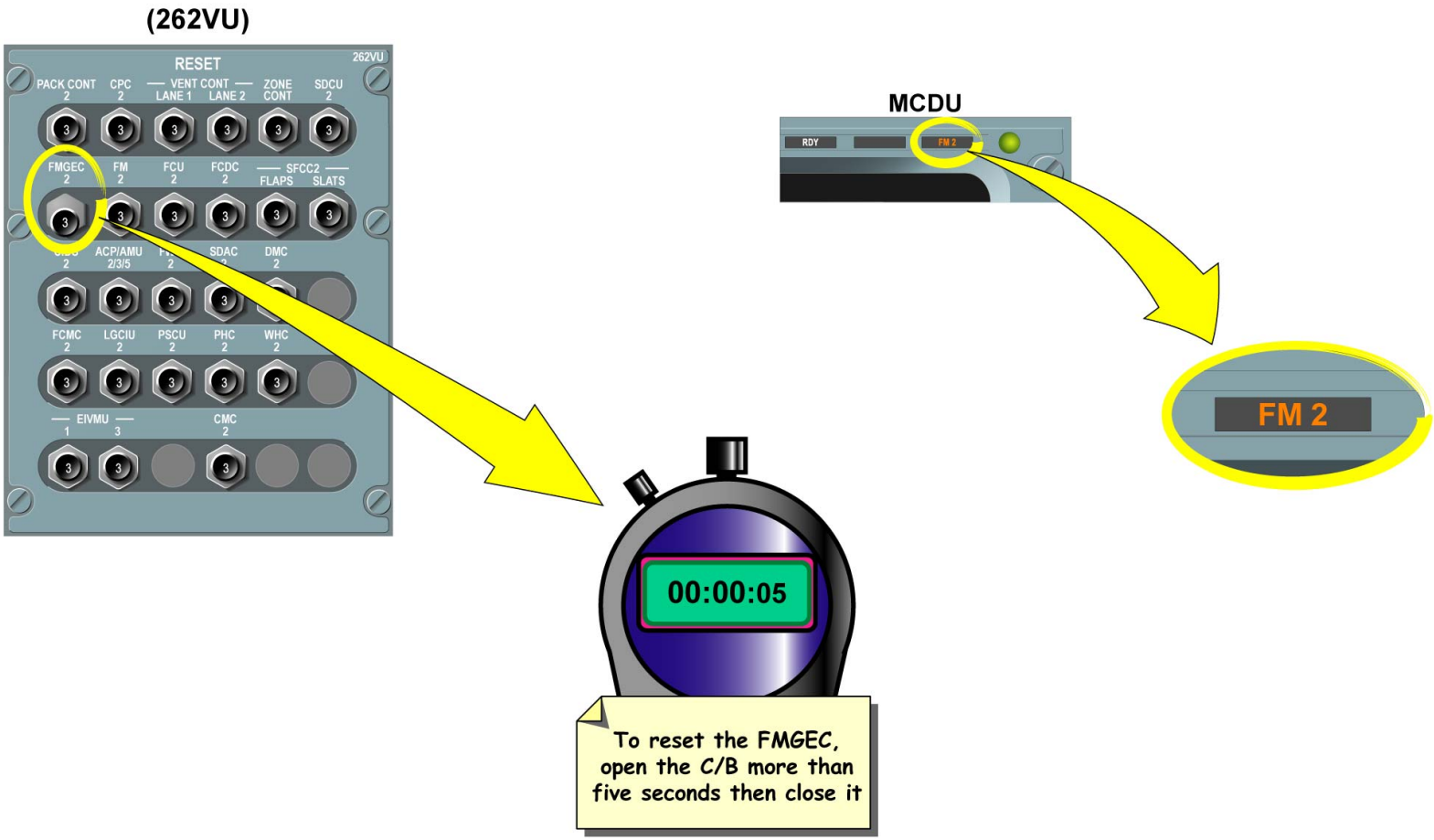
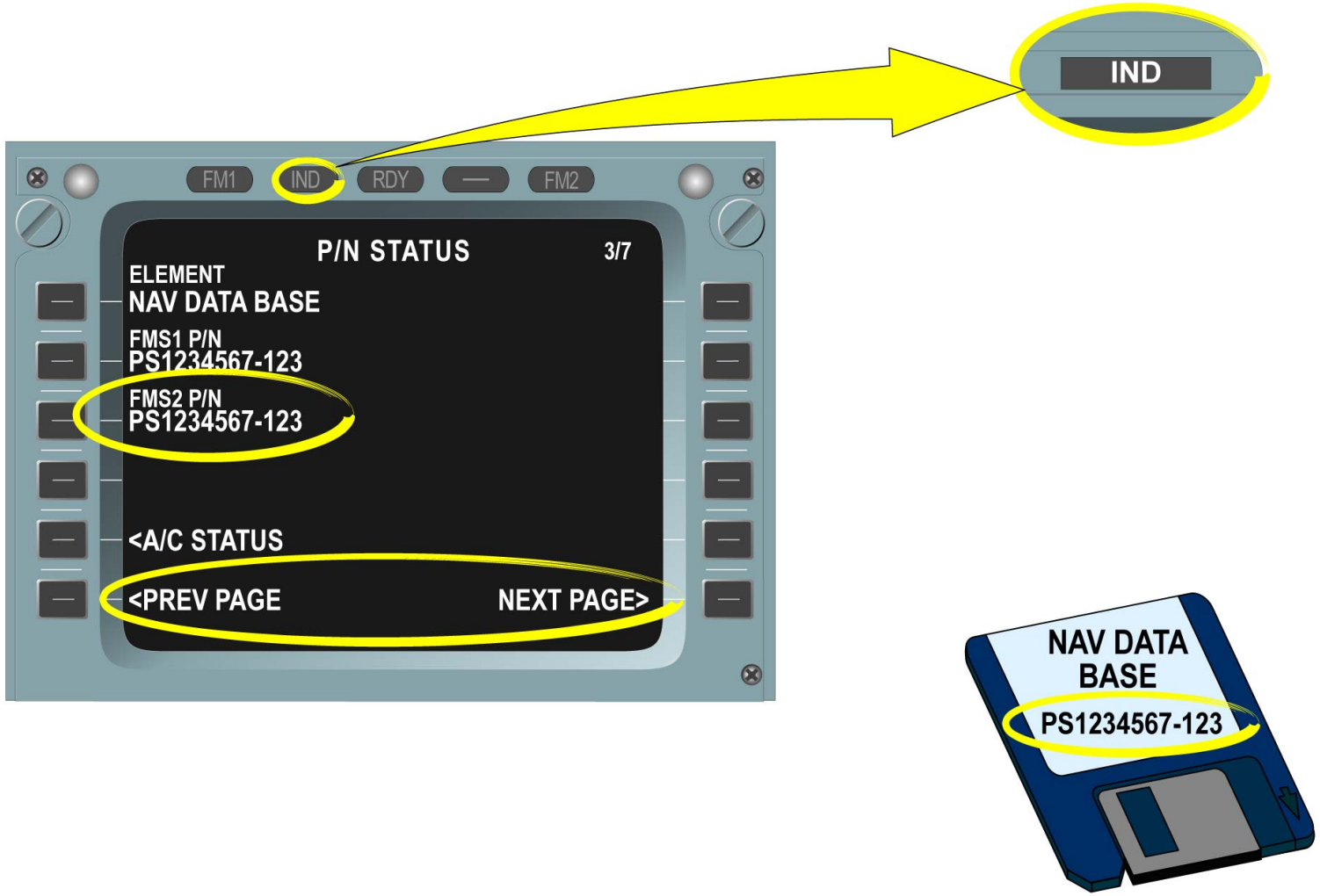
UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA OF THE FMGEC:

Uploading of the FMGEC



UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - CROSSLOADING PROCEDURE

G9409341 - GAUT0T0 - FM22B1000000001



UPLOADING (WITH THE MDDU/DLS) AND CROSSLOADING OF DATA TO THE FMGEC - CROSSLOADING PROCEDURE

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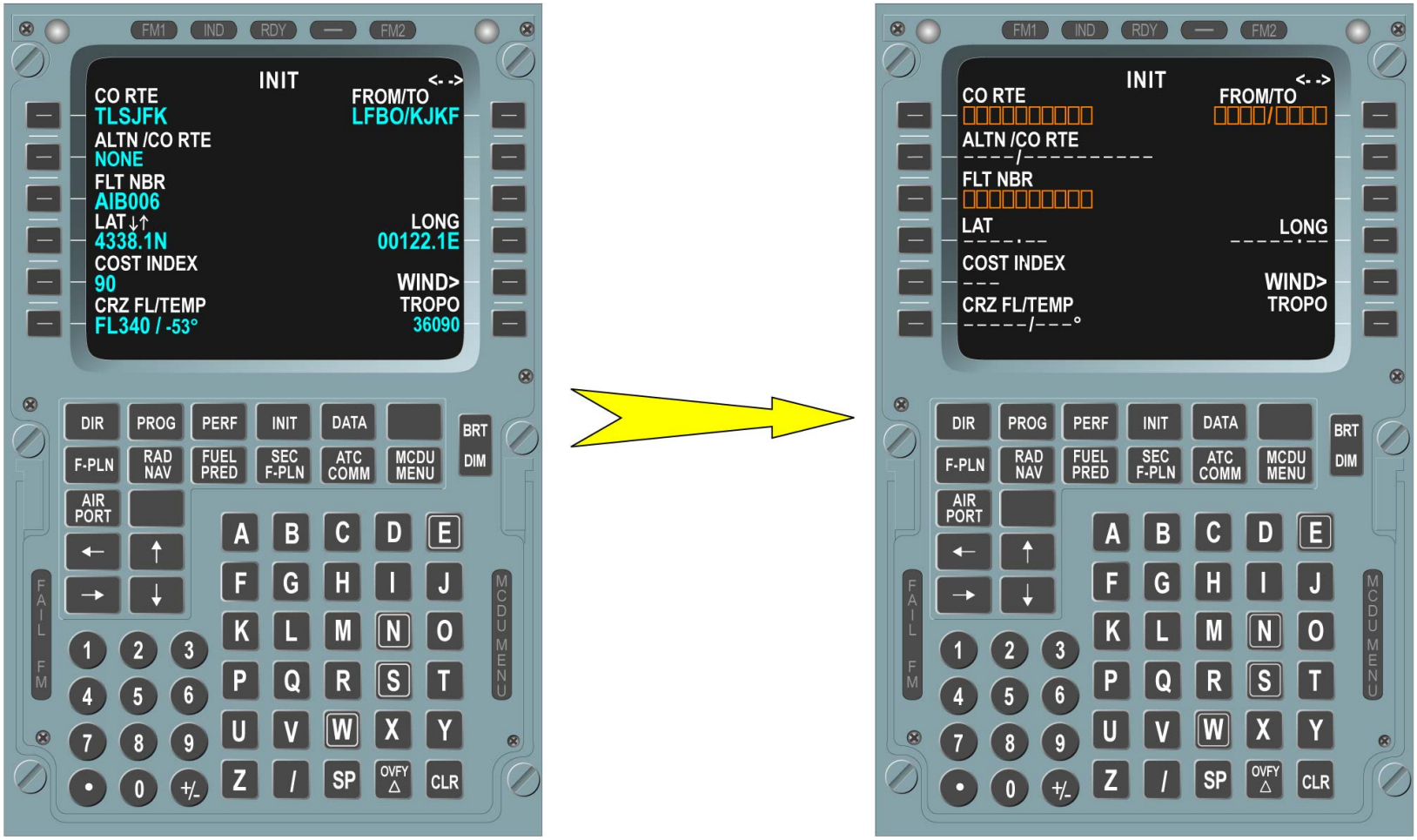
AUTO FLIGHT LINE MAINTENANCE BRIEFING (2)

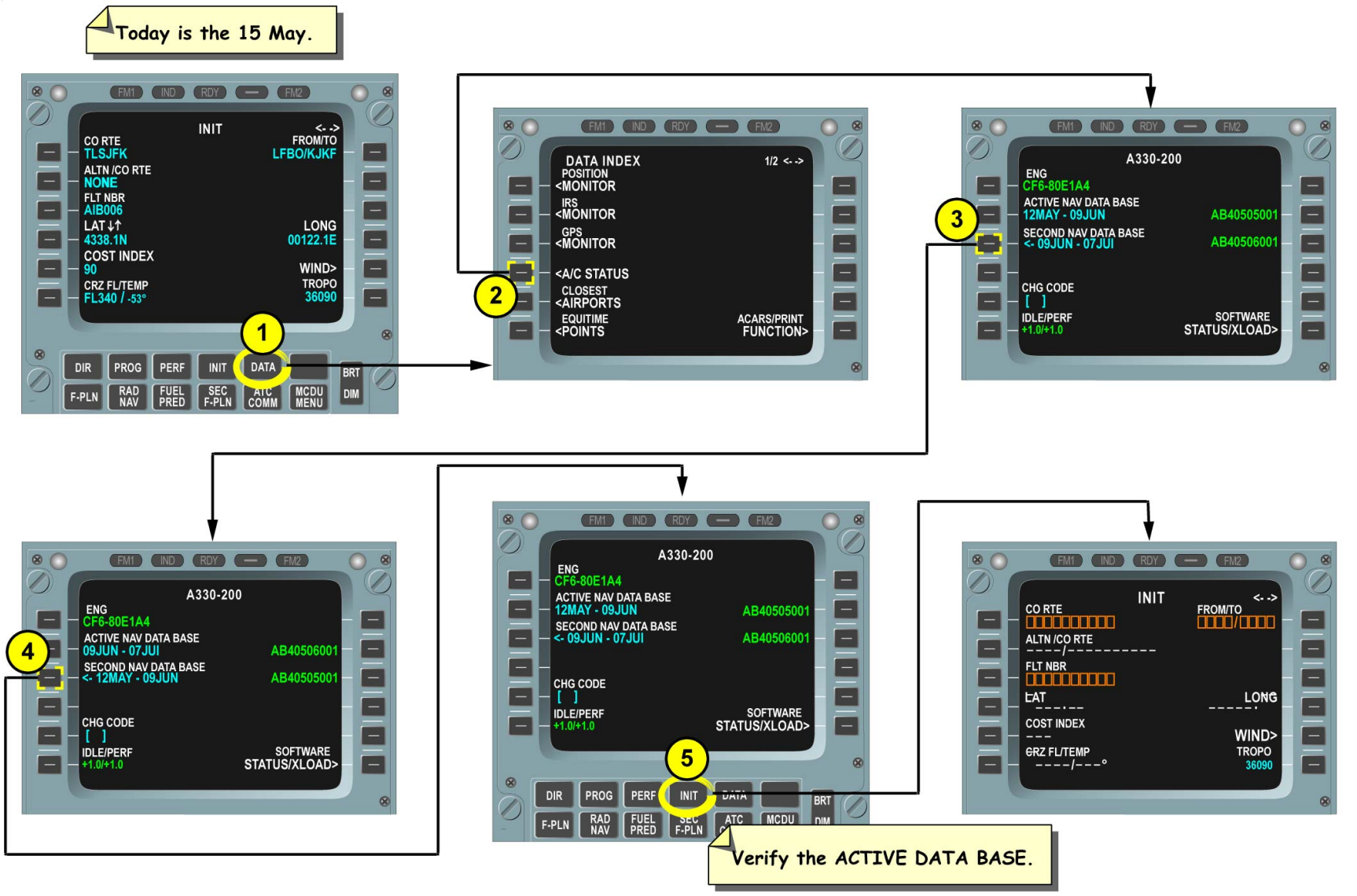
MAINTENANCE TIPS

DELETE A FLIGHT PLAN FROM THE MCDU INIT A PAGE

To carry out some maintenance actions, it can be necessary to enter a basic flight plan, for example to make an engine run-up. The process below explains how to delete such a flight plan, leaving the "INIT A" page in its initial condition.
On MCDU 1 or 2, press the "DATA" mode key, "DATA INDEX page 1" appears. Select "A/C STATUS" page, select "SECOND DATA BASE", wait a few seconds: ACTIVE and SECOND DATA BASE dates and numbers are transposed. The flight plan data is deleted. Select "SECOND DATA BASE" again (the data base lines are retransposed). Verify the "ACTIVE DATA BASE" is valid (not out of date). Press "INIT" mode key and verify that "INIT A" page is erased.



MAINTENANCE TIPS - DELETE A FLIGHT PLAN FROM THE MCDU INIT A PAGE



MAINTENANCE TIPS - DELETE A FLIGHT PLAN FROM THE MCDU INIT A PAGE

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FLIGHT ENVELOPE GENERAL DESCRIPTION (3)

GENERAL

In addition to the acquisition of the aircraft parameters used by the Auto Flight System (AFS), the Flight Envelope (FE) function basically consists of the speed envelope computation and the detection of abnormal flight conditions.

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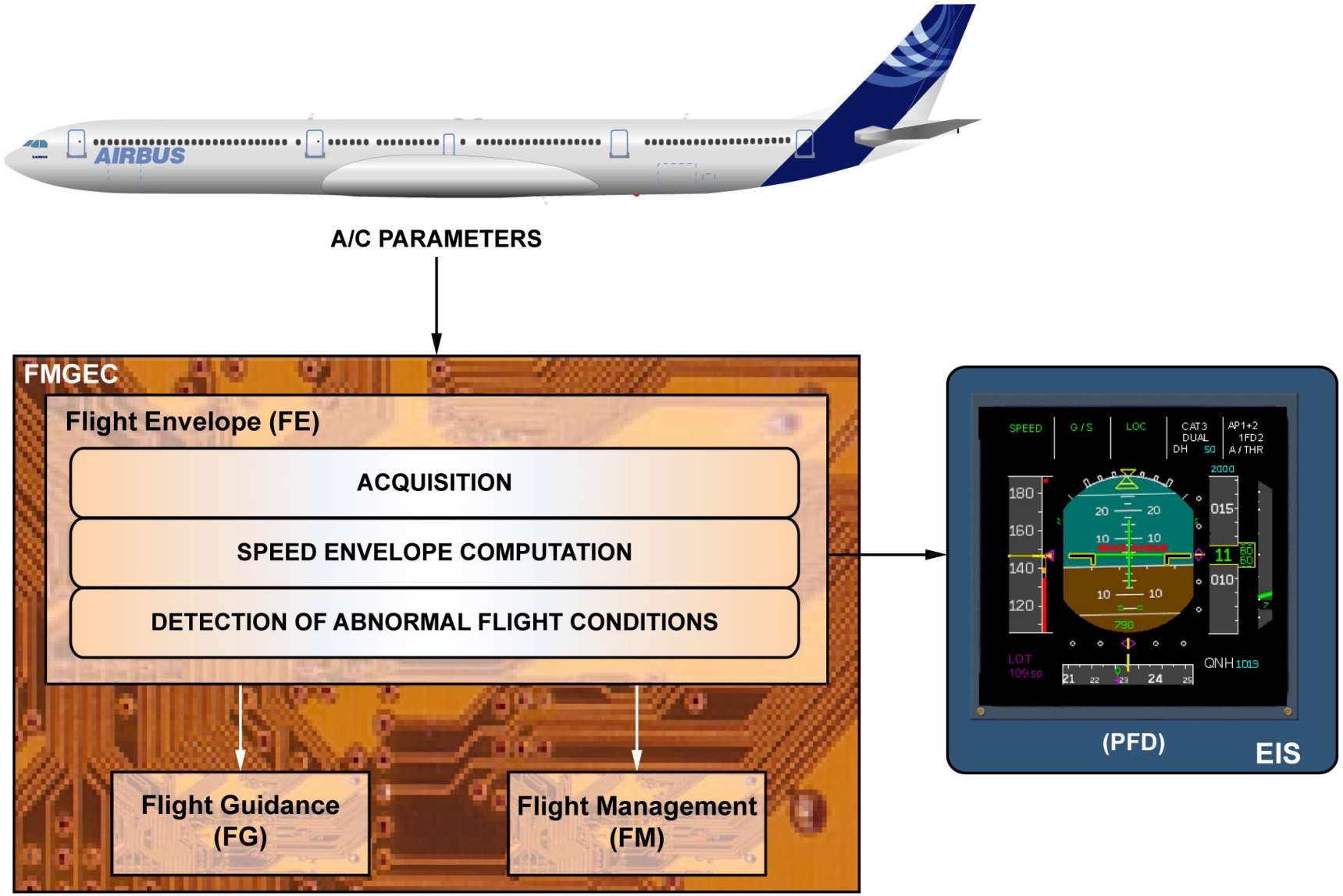
AIRBUS
A/C PARAMETERS
FMGEC
Flight Envelope (FE)
ACQUISITION
SPEED ENVELOPE COMPUTATION
DETECTION OF ABNORMAL FLIGHT CONDITIONS
Flight Guidance (FG)
Flight Management (FM)
SPEED
G/S
LOC
CAT3 DUAL
DH 50
AP1+2
1FD2
A/THR
2000
180
160
140
120
015
010
11
80
60
LOT
109.50
QNH 1013
(PFD)
EIS

GENERAL

FLIGHT ENVELOPE GENERAL DESCRIPTION (3)

ACQUISITION AND MONITORING

The Flight Envelope function ensures the acquisition and monitoring of the various aircraft parameters used by the Flight Envelope, Flight Guidance (FG) and Flight Management (FM) functions except those specific to the Flight Management.
In particular, the Flight Envelope function acquires the alphafloor detection signal computed from the Flight Control Primary Computers (FCPCs) and, if valid, sends it to the Flight Guidance function for alphafloor protection.
Dialog between the three functional parts takes place via two common memories, one between the Flight Envelope and the Flight Guidance part, another between the Flight Guidance and the Flight Management part.

AIRCRAFT CONFIGURATION

The Flight Envelope function determines the aircraft configuration specifically for the Flight Envelope and Flight Guidance functions.
For that purpose, the Flight Envelope function acquires the ground/flight conditions from the Landing Gear Control and Interface Units (LGCIUs), the slat/flap configuration from the Slat Flap Control Computers (SFCCs) and the engine on/off data from the Full Authority Digital Engine Control (FADEC) computers.

WEIGHT AND CG

The aircraft gross weight and Center of Gravity (CG) position data are computed in parallel by the Fuel Control and Monitoring Computers (FCMCs) and the Flight Envelope function itself. The Flight Envelope function ensures the selection of this data, which is then used by the Flight Envelope, Flight Guidance, Flight Management and the flight controls.
If at least one FCMC is valid, the Flight Envelope function uses the aircraft gross weight and the CG position from the FCMC. If both FCMCs are lost, the Flight Envelope function selects its own computations.

SPEED ENVELOPE COMPUTATION

The Flight Envelope function computes the speed envelope consisting of the characteristic speeds, these being the maneuvering speeds and speed limits. These speeds are used either by the crew or by the Flight Guidance automation to safely fly the aircraft within the speed envelope.
Note that most of these speeds are obtained from VS (stall speed) delivered by the FCPCs. The speeds are displayed on the speed scale of the EFIS PFDs.

ABNORMAL FLIGHT CONDITIONS DETECTION

The Flight Envelope function detects the presence of several abnormal flight conditions.

AFT CG

The two FCMCs control the aft CG by transferring fuel to and from the trim tank to reduce drag. The Flight Envelope function monitors aft CG limit overshoot by a computation fully independent of the FCMCs. In case of aft CG limit overshoot, a warning is generated. This computation is active in clean configuration over 20,000 feet.

LATERAL ASYMMETRY

The Flight Envelope function ensures the detection of lateral asymmetry by comparing the left and right engine thrusts. This condition is used for the Flight Envelope computations and Flight Guidance function.

WINDSHEAR

The Flight Envelope function computes a signal to provide a visual windshear warning on the PFDs and an audio warning through the

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loudspeakers. Note that it has no authority on the autothrust and is only active if slats and flaps are extended.

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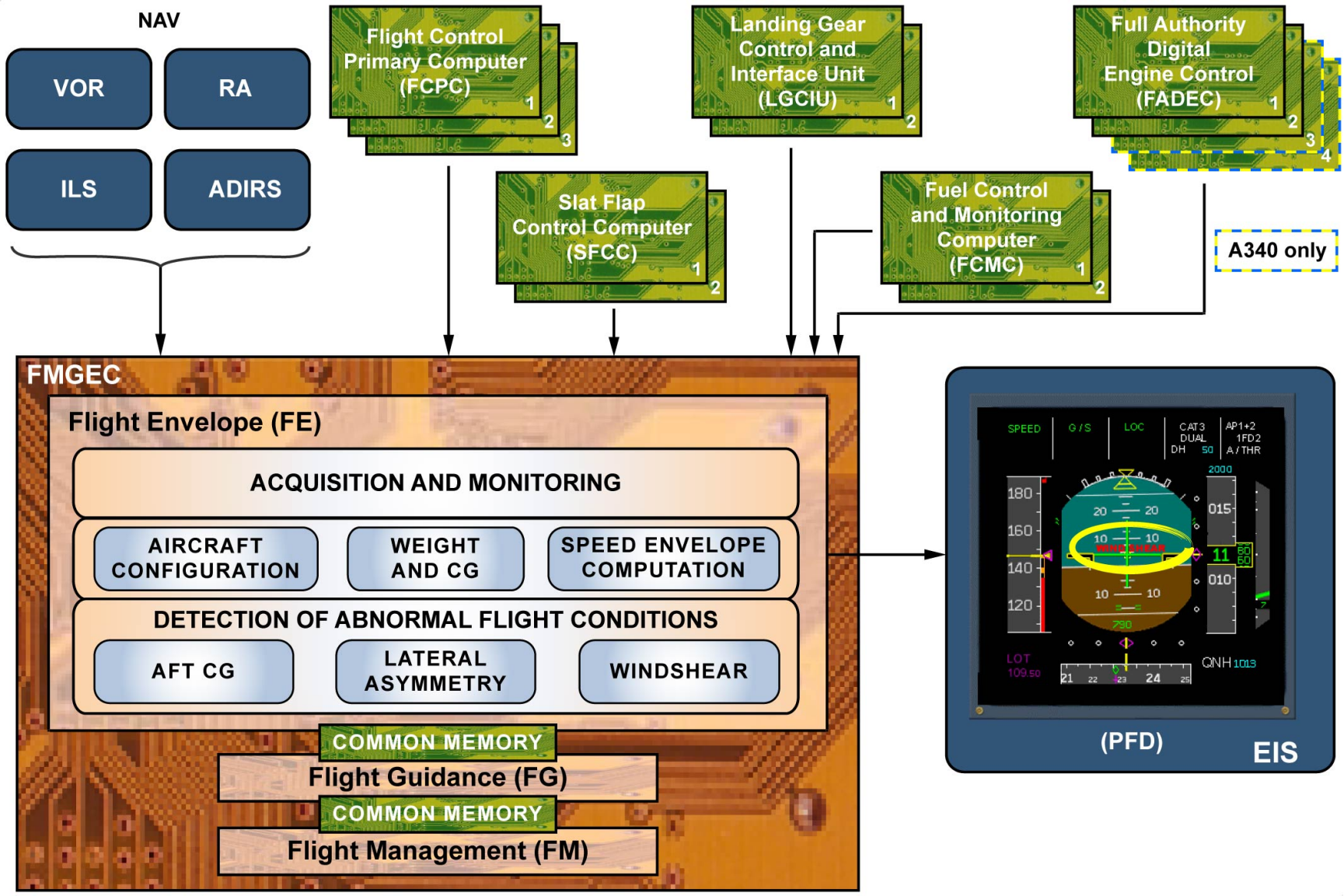

ACQUISITION AND MONITORING ... ABNORMAL FLIGHT CONDITIONS DETECTION

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FLIGHT ENVELOPE PROTECTION D/O (3)

GENERAL

The Flight Envelope (FE) part detects A/C configurations outside the normal flight envelope such as windshear conditions and aft Center of Gravity (CG) out of tolerated limit. The FE part also acquires and transmits the alphafloor signal from the Flight Control Primary Computers (FCPCs) to the Flight Guidance (FG) part.
FE processing is autonomous. A single detection by one of the two Flight Management Guidance and Envelope Computers (FMGECs) is enough to activate one of these three functions.
The FE function computes the limit and manoeuvering speeds which are displayed on the speed scale of the PFD.

DETECTION AVAILABILITY

Windshear detection, aft CG detection or alphafloor detection depend on flight conditions. Windshear detection is available during 30 seconds after take-off under 250 feet Radio Altimeter (RA) and from 1300 feet RA to 50 feet RA in approach. It is inhibited in clean configuration.
Alphafloor acquisition is available from take-off to a radio altitude of 100 feet before landing.

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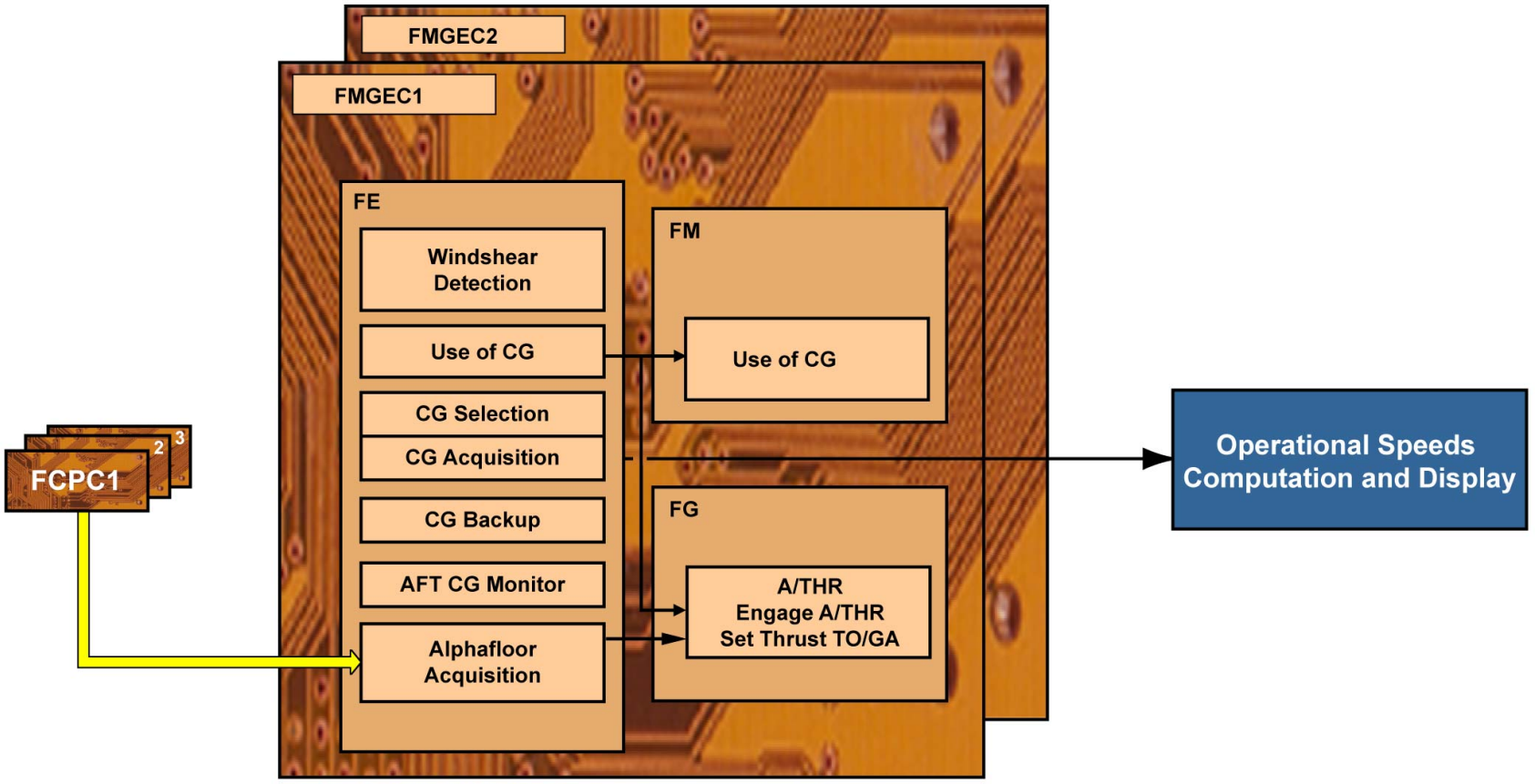

GENERAL & DETECTION AVAILABILITY

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FLIGHT ENVELOPE PROTECTION D/O (3)

WINDSHEAR DETECTION

If windshear is detected, the FE function computes a windshear warning. A visual indication is given on the PFD and an aural warning can be heard from the cockpit loudspeakers. This signal computation is based on an algorithm taking into account longitudinal shears, vertical acceleration, wind components given by the Air Data and Inertial Reference Unit (ADIRU) and slat/flap position given by the Slat Flap Control Computer (SFCC).

WINDSHEAR WARNING

The warning is triggered depending on the shear intensity and a minimal safe A/C energy (according to speed and flight path).

NOTE: Note that if both RAs have failed, the windshear warning is not available. This warning loss is displayed on the ECAM status page.

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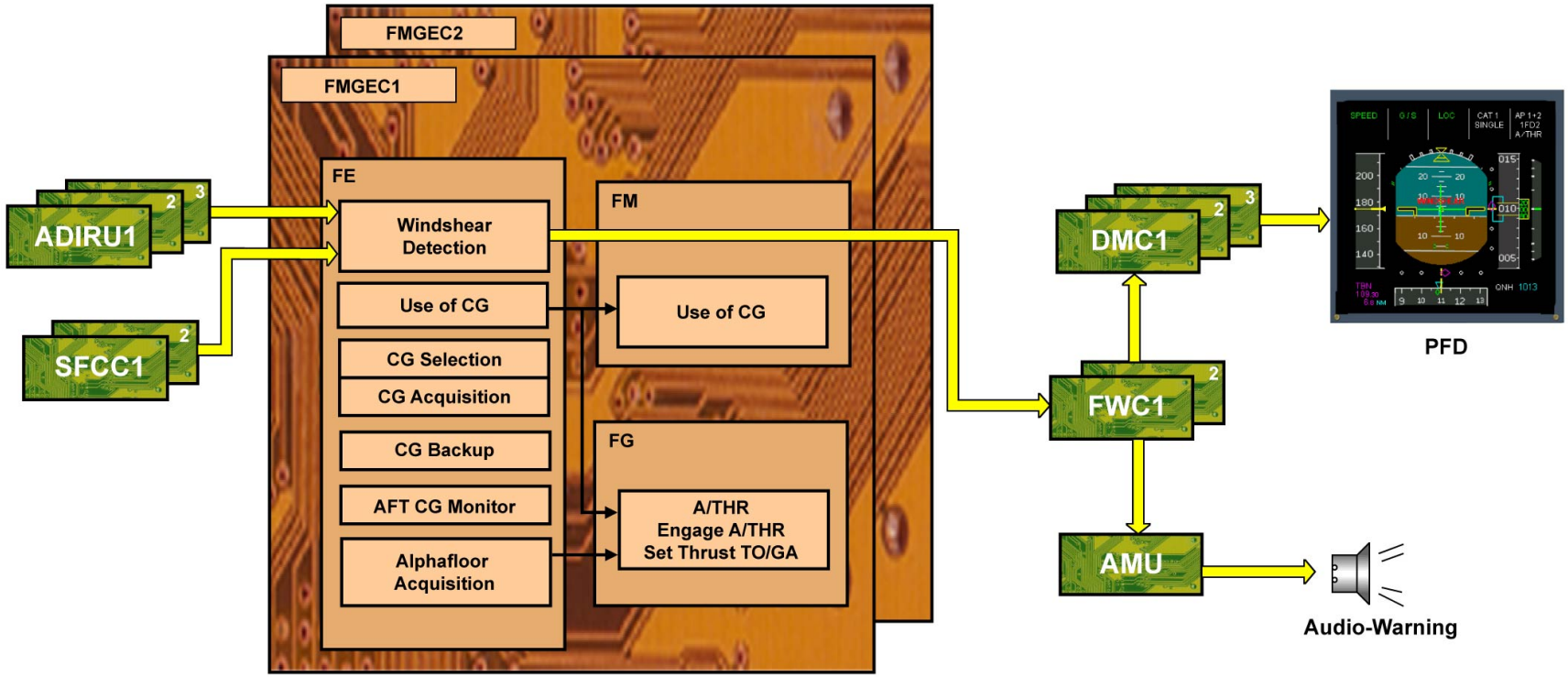

WINDSHEAR DETECTION - WINDSHEAR WARNING

FLIGHT ENVELOPE PROTECTION D/O (3)

AFT CENTER OF GRAVITY DETECTION

In order to improve A/C performance, the Fuel Control and Monitoring Computer (FCMC) controls the CG position by transferring fuel forward. The FE function monitors the non-overshoot of the aft CG limits by a computation fully independent of the FCMC.

AFT CG OVERSHOOT

If the FE GC is greater than the aft CG caution limit, the information is transmitted to the FCMC which stops fuel transfer during a time limit.

AFT CG WARNING

The FE function provides the Flight Warning Computers (FWCs) with a CG monitoring availability signal. If the CG is greater than the limit CG, the FE function sends an aft CG warning signal followed by an ECAM message to the FWCs.
Aft CG warning and caution are computed with CG and weight estimations made by the FE part, independently of the FCMC, mainly by using THS deflection.

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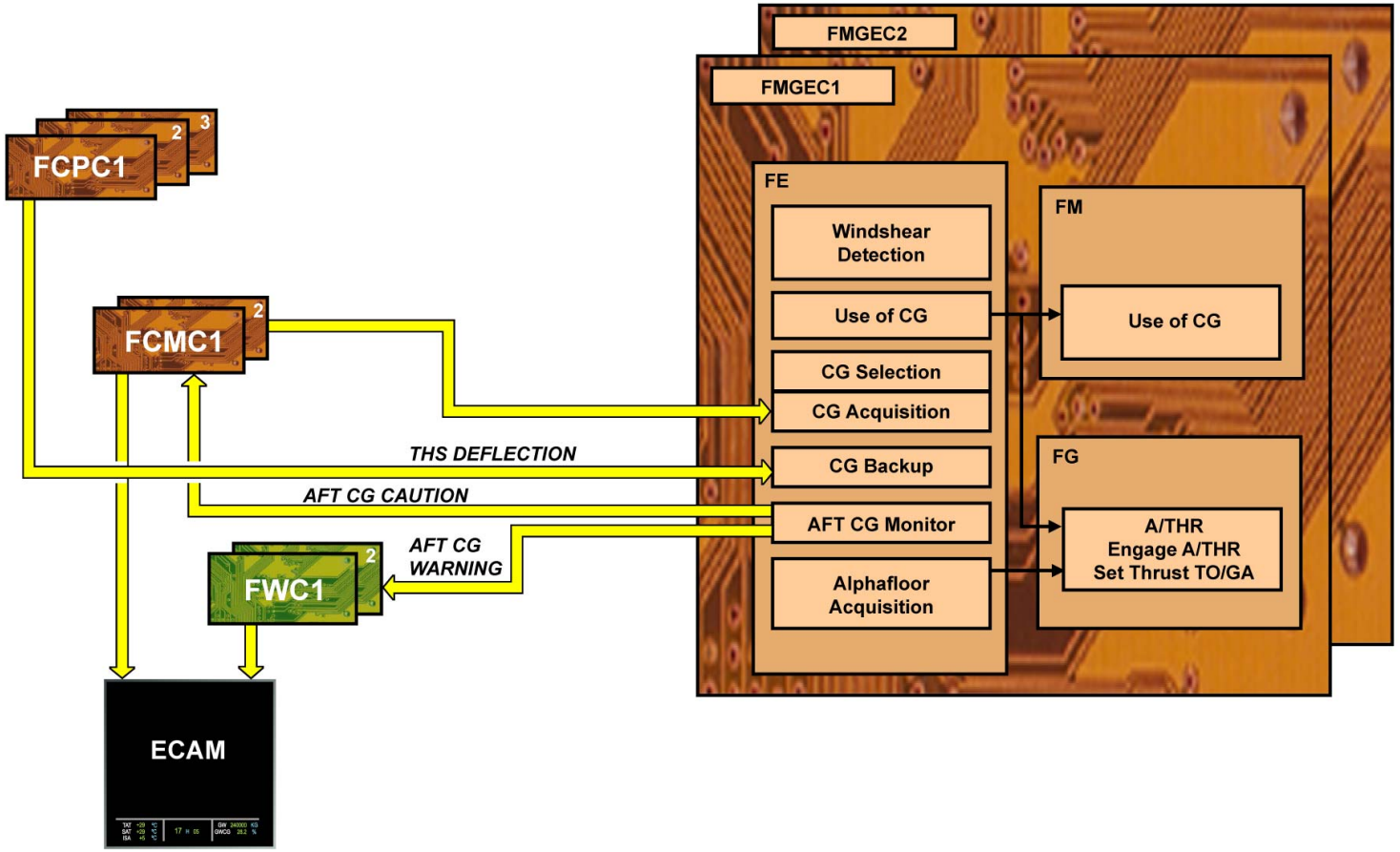

AFT CENTER OF GRAVITY DETECTION - AFT CG OVERSHOOT & AFT CG WARNING

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FLIGHT ENVELOPE PROTECTION D/O (3)

ALPHAFLOOR ACQUISITION

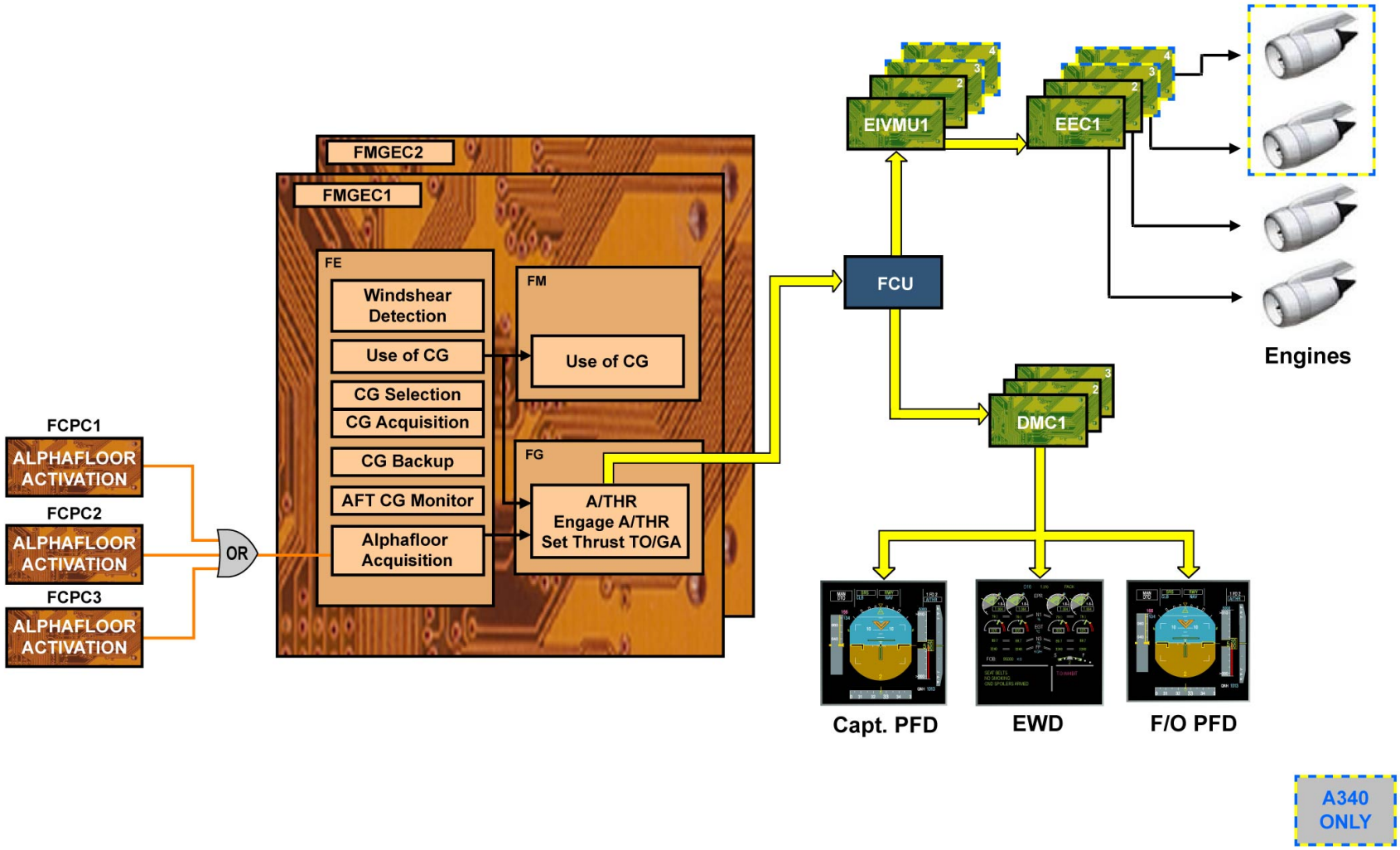
The FE part only acquires the Alphafloor detection/activation signal coming from the FCPC. This creates the Alphafloor condition. The FE part is involved as a letter box between the FCPCs and the FG part. The alphafloor condition is used by the FG part and the opposite FMGEC.

ALPHAFLOOR PROTECTION OF THE AUTOTHRUST

The alphafloor protection of the autothrust function is active when the detection is performed by at least one of the three FCPCs. The Alphafloor acquisition function has full authority on the autothrust via the FG part. It forces the autothrust to Take-Off/Go-Around (TO/GA) thrust even if the autothrust was not previously engaged. The full thrust signal is sent to the engines via the Flight Control Unit (FCU), the Engine Interface and Vibration Monitoring Unit (EIVMU) and the Electronic Engine Controls (EECs).

ALPHAFLOOR WARNING MESSAGES

Warning messages are displayed on the PFD and on the EWD. The FE function provides the Display Management Computers (DMCs) via the FCU with a Flight Mode Annunciator (FMA) amber message A. FLOOR in the autothrust zone and an EWD amber message A FLOOR at the top left of the screen.



ALPHAFLOOR ACQUISITION - ALPHAFLOOR PROTECTION OF THE AUTOTHRUST & ALPHAFLOOR WARNING MESSAGES

FLIGHT ENVELOPE PROTECTION D/O (3)

OPERATIONAL SPEED COMPUTATION AND DISPLAY

Now the operational speeds will be explained.

F SPEED

F speed is the minimum flap retraction speed and corresponds to the speed at which flaps can be retracted.
F speed is available on the PFD one second after shock absorber extension and when the slat/flap lever is in positions 3 or 2. F speed is represented by a green F on the speed scale.

S SPEED

S speed is the minimum slat retraction speed: it corresponds to the speed at which slats can be retracted.
S speed is available on the PFD one second after shock absorber extension and when the slat/flap lever is in position 1. S speed is represented by a green "S" on the speed scale.

VLS

The Lowest Selectable Speed (VLS) is the minimum selectable speed for the actual slat and flap configuration taking into account the control lever position, the real surface position and the speedbrake configuration. The VLS provides a safety margin in order to avoid stalling at low speed and buffeting during cruise (throughout the FE). It is used by the Automatic Flight System (AFS) in order to prevent speed undershoot.
VLS is displayed one second after shock absorber extension and for all slat/flap configurations. It is represented by the top of an amber strip in the lower part of the speed scale.

VMAN GREEN DOT

The Manoeuvering Speed (VMAN) is a function of the weight, the altitude and the number of engines running. It is the optimum speed in the event of one engine failure. VMAN (manoeuvering speed or green dot) is limited by the maximal operational speed (VMAXOP) and the VLS. VMAN is available when the A/C is in flight and in clean configuration.
It is represented on the PFD by a green dot on the speed scale.

VMAXOP

VMAXOP is the maximum operational speed used as a limit in the FG part.

NOTE: Note that it is not represented on the PFD.
In clean configuration, the maximal operational speed corresponds to the buffeting limit at 0.2 g with respect to weight and altitude. It is limited by the maximal speed (VMAX) minus 5 kts and the VLS in clean configuration.
With flaps and slat extended, VMAXOP is limited by the maximum Flap Extended Speed (VFE) and VLS.

VMAX

VMAX speed is the maximum speed and it is used by the AFS in order to prevent excessive speed.
The maximum speed (VMAX) corresponds to the Maximum Operating Speed/Mach (VMO/MMO) in clean configuration and L/G retracted. In clean configuration but with L/G extended, VMAX corresponds to the Maximum Landing Gear Extended Speed (VLE). With slats and flaps extended, VMAX corresponds to the Maximum Flap Extended Speed (VFE).
It is defined on the PFD by the lower end of a red and black strip in the upper part of the speed scale.

VFEN

VFEN corresponds to the maximum flap and slat extension speed of the next slat/flap configuration. The predictive maximum flap extended speed at the next slat/flap position depends only on the slat/flap control lever position.

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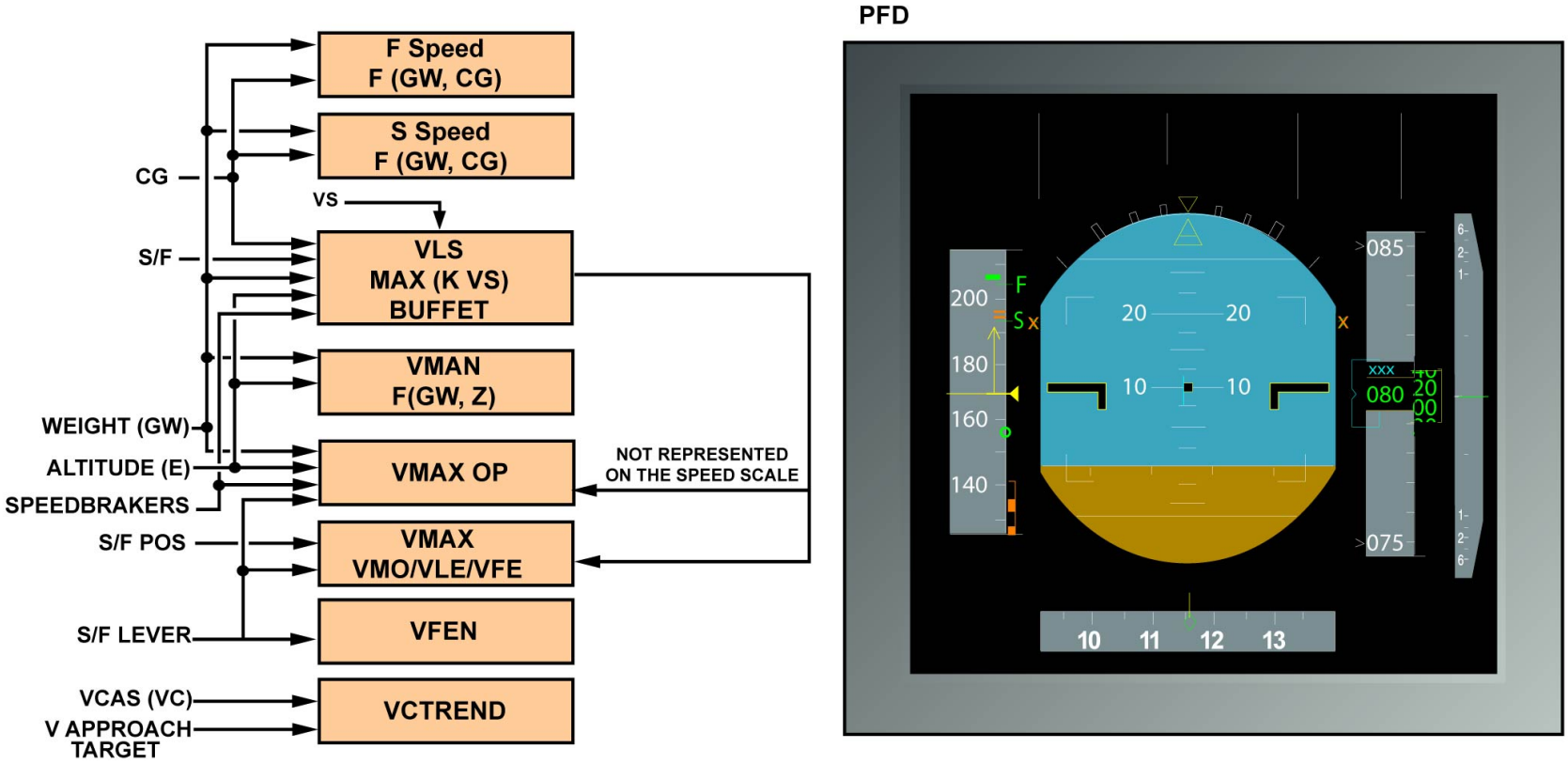
VFEN is displayed on the PFD below 14,625 ft except when flaps are fully extended and it is indicated by two amber dashes.

VCTREND

VCTREND represents the airspeed tendency, that means the A/C acceleration or deceleration. The airspeed tendency is computed to represent the speed that the A/C would have 10 seconds later if the acceleration remained constant.
VCTREND is displayed on the PFD if VC is higher than 30 kts and it is defined by a yellow pointer initiating an A/C actual speed symbol.



OPERATIONAL SPEED COMPUTATION AND DISPLAY - F SPEED ... VCTREND

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FLIGHT GUIDANCE GENERAL DESCRIPTION (3)

GENERAL

The Flight Guidance (FG) functional portion of the Flight Management Envelope and Guidance Computers (FMGECs) performs three functions:
- Autopilot (AP),
- Flight Director (FD),
- Autothrust (A/THR).

The FG part contains the engagement logics, the operational mode logics and the control laws associated to these functions. The control laws provide AP guidance orders, FD orders and a thrust command to stabilize and to guide the aircraft.
Note that, because there are no longer any autopilot actuators, there are no power loops inside the FG.

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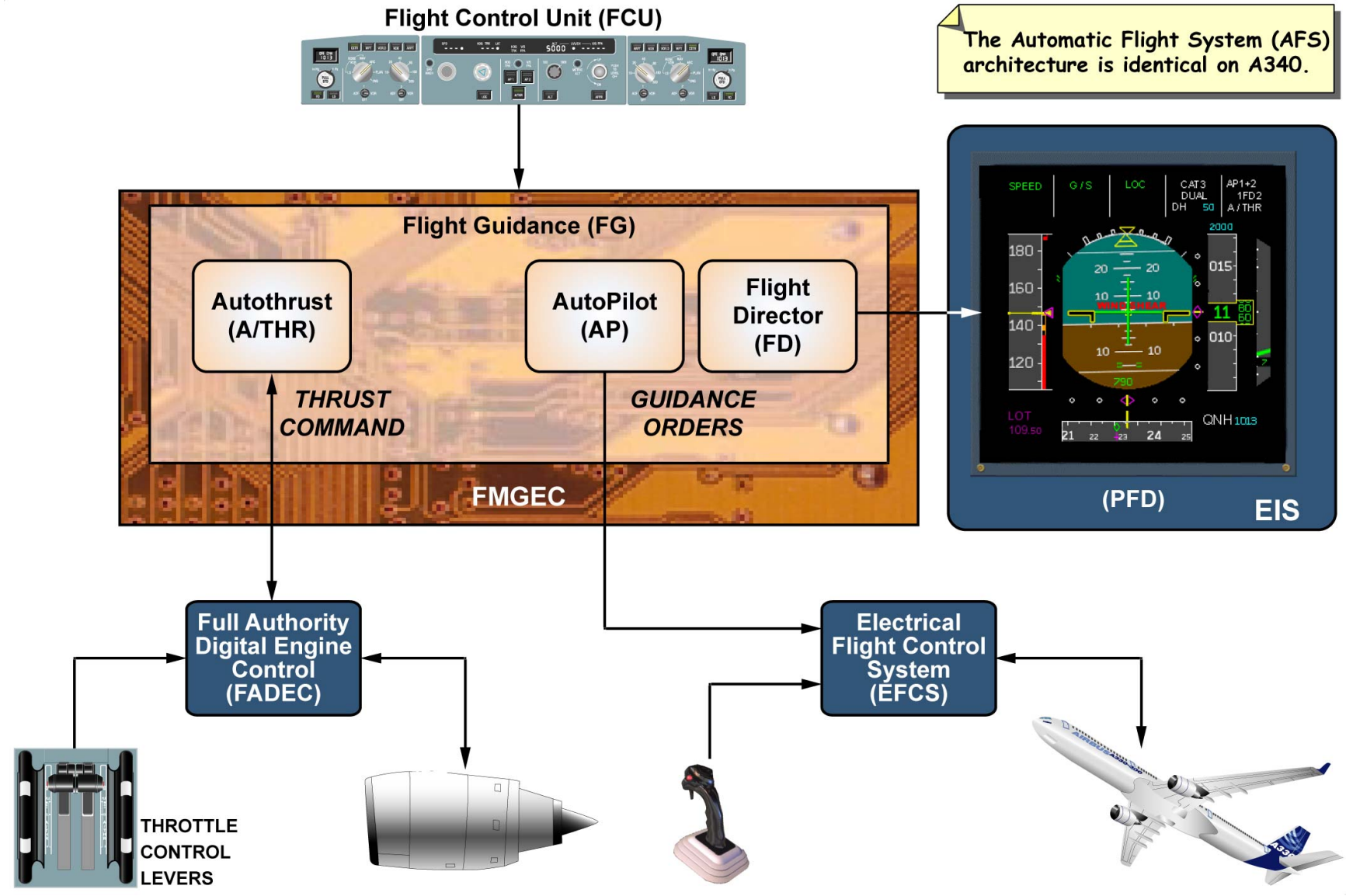
Flight Control Unit (FCU)
The Automatic Flight System (AFS) architecture is identical on A340.
Flight Guidance (FG)
Autothrust (A/THR)
AutoPilot (AP)
Flight Director (FD)
THRUST COMMAND
GUIDANCE ORDERS
FMGEC
SPEED
G/S
LOC
CAT3 DUAL
DH 50
AP1+2 1FD2 A/THR
(PFD)
EIS
Full Authority Digital Engine Control (FADEC)
Electrical Flight Control System (EFCS)
THROTTLE CONTROL LEVERS

GENERAL

FLIGHT GUIDANCE GENERAL DESCRIPTION (3)

AUTOPILOT FUNCTION

The autopilot function computes lateral and longitudinal guidance orders used by the Flight Control Primary Computers (FCPCs) for automatic deflection of the flight control surfaces as well as for nose wheel steering through the Braking/Steering Control Unit (BSCU). The autopilot functions are:
- acquisition and holding of a flight path and stabilization of the aircraft around its Center of Gravity (CG),
- acquisition and holding of a flight level,
- acquisition and holding of a speed,
- automatic landing including roll-out,
- go around.

FLIGHT DIRECTOR FUNCTION

When the autopilot is not engaged, the Flight Director (FD) function displays guidance orders to the pilot to apply on the controls to follow the optimum flight path which would be ordered by the autopilot if it was engaged. The FD guidance orders are displayed on the center section of the EFIS PFDs:
- generally pitch and roll orders,
- a yaw order during take-off and landing.

When the autopilot is engaged, the FD function displays the autopilot orders.

AUTOTHRUST FUNCTION

The autothrust (A/THR) function sends a computed thrust command (thrust target) to the Full Authority Digital Engine Control (FADEC) for automatic engine control. The A/THR functions are:
- acquisition and holding of a speed or a mach number,
- acquisition and holding of a thrust,
- reduction of the thrust to idle during descent and during flare in final approach,
- protection against excessive angle-of-attack (called alphafloor protection) by ordering a maximum thrust when an alphafloor detection signal is received from the Flight Envelope (FE) functional part.

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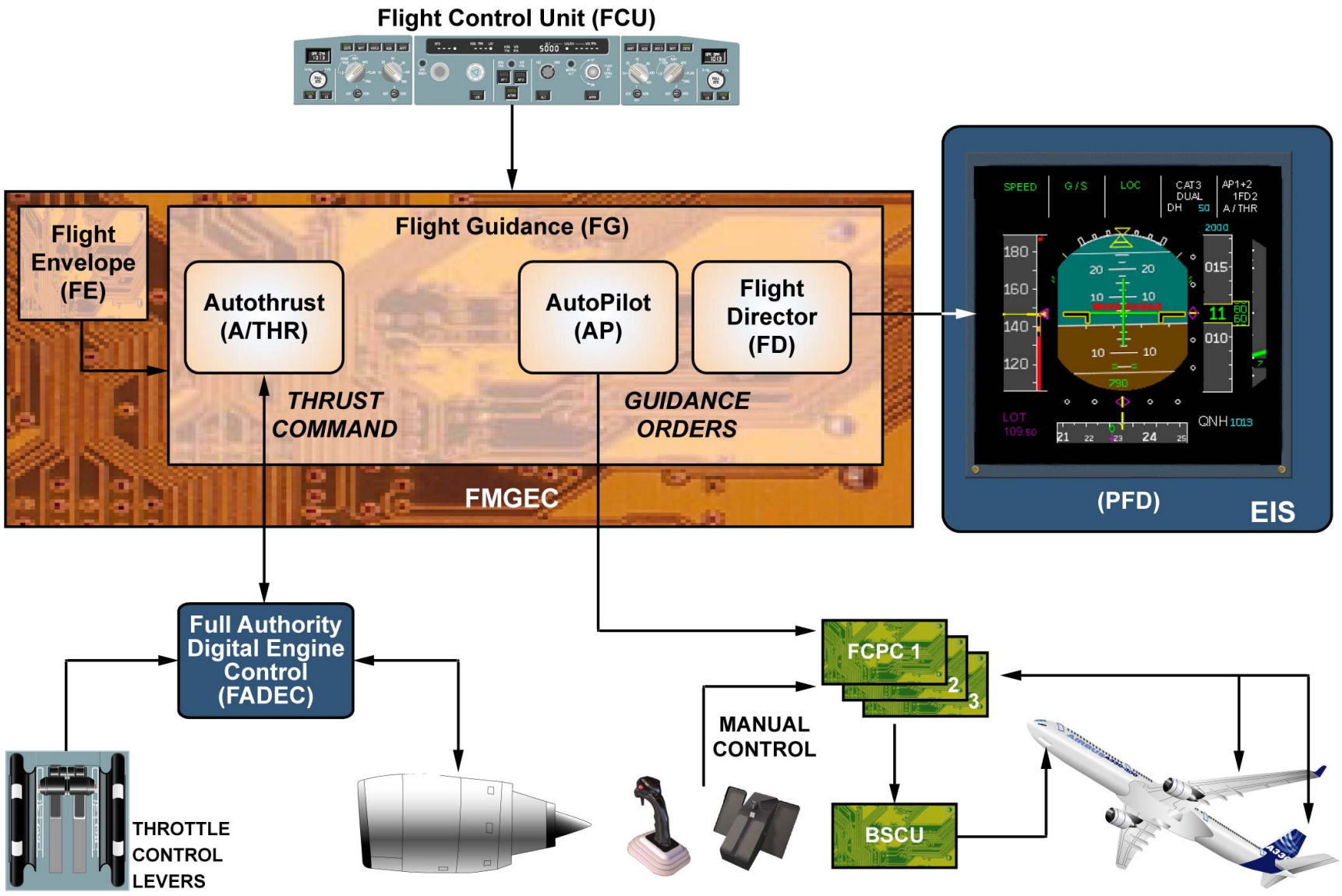

AUTOPILOT FUNCTION ... AUTOTHRUST FUNCTION

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FLIGHT GUIDANCE GENERAL DESCRIPTION (3)

FLIGHT DIRECTOR ENGAGEMENT

The FD is automatically engaged at FMGEC power-up and the 2 dedicated FCU P/Bs are lit. However, the FD guidance orders will be displayed on the PFDs from take-off only. Then, they can be displayed or not by using the same FCU P/Bs. The FD engagement status is displayed on the FMA.
The following AP/FD common conditions must be satisfied to allow engagement:
- the FMGEC must receive data from at least two valid Air Data and Inertial Reference Units (ADIRU). When two ADIRUs are lost, the Inertial Reference/Air Data Reference (IR/ADR) condition disengages the AP/FD,
- the FCU must always be seen valid by the FMGEC except in land track or Go Around modes,
- each FMGEC monitors the validity of the Radio Altimeter (RA). One of the RA must be valid during the approach phase. The condition is inhibited in roll out mode to reduce the risk of AP loss in this phase,
- each FMGEC monitors the parameters transmitted by both ILS receivers,
- the roll-out mode must be valid,
-the lateral and longitudinal flight plans must be valid as soon as the final descent mode is armed. If final descent mode is not armed, the loss of lateral or longitudinal flight plans leads to reversion in HDG and V/S modes (AP remains engaged).
- the AP/FD/A/THR common condition is needed.

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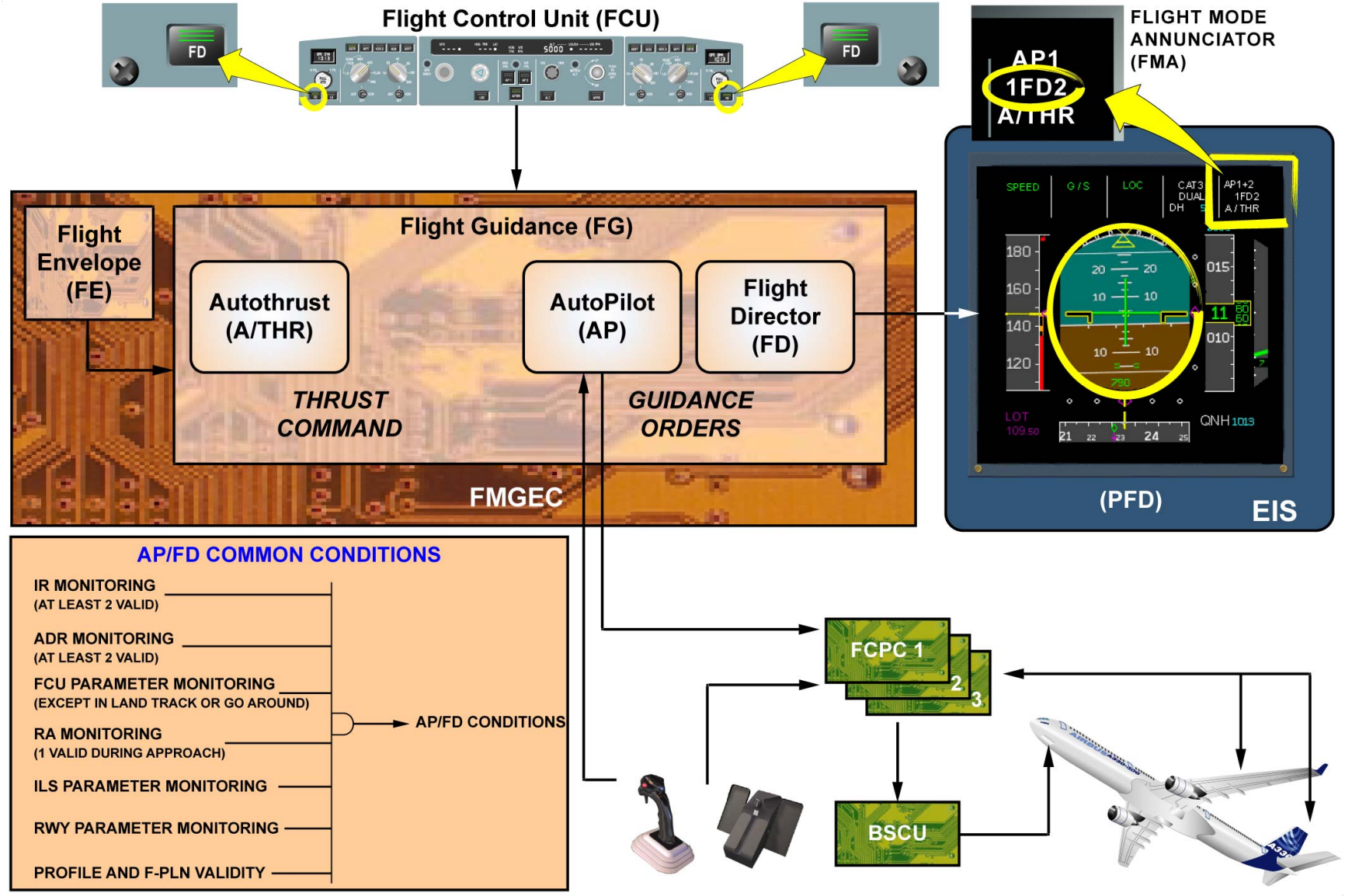

FLIGHT DIRECTOR ENGAGEMENT

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FLIGHT GUIDANCE GENERAL DESCRIPTION (3)

AUTOPILOT ENGAGEMENT

Autopilot engagement is always done manually through 2 dedicated Flight Control Unit (FCU) P/Bs. Only one autopilot can normally be engaged at a time. Dual autopilot engagement is possible, but in approach and go around phases (to maximize the autopilot availability during automatic landing). When the autopilot is engaged:
- the associated FCU AP P/B is lit,
- the engagement status is displayed on the Flight Mode Annunciator (FMA) of the PFDs,
- the side sticks are locked and the rudder pedals feel force threshold is increased.

Autopilot disengagement can be done manually or automatically.
Manually, at any time on ground or in flight:
- either through the associated FCU P/B (AP engagement feedback),
- or through the side sticks by an unlocking action or by pressing the take-over priority P/BSWs,
- or through the rudder pedals.

Automatically, in case of failure detection or protection activation (for example, overspeed protection).
To engage or disengage the AP, the following specific conditions must be covered:
- the AP engagement is confirmed by the feedback of four AP ENGD discretes generated by each FMGEC,
- disengagement through the AP takeover and priority P/BSWs,
- each FMGEC command and monitoring channel receives engagement enable discretes from the FCPC command and monitoring channels,
- condition specific to Go Around and roll out mode. On the ground, the AP disengages when the Go Around mode is engaged or when the throttle control levers are positioned above the Maximum Continuous Thrust (MCT) position. At the end of the roll out mode, on ground, if both APs are engaged, the AP2 disengages.

On top of the above, the AP/FD common conditions and the AP/FD/A/THR conditions must be fulfilled too. The AP engagement has also operational limitations:
- aircraft speed must be within Lower Selectable Speed (VLS) and Vmax,
- aircraft pitch angle does not exceed 10 degrees nose down or 22 degrees nose up,
- bank angle is less than 40 degrees.

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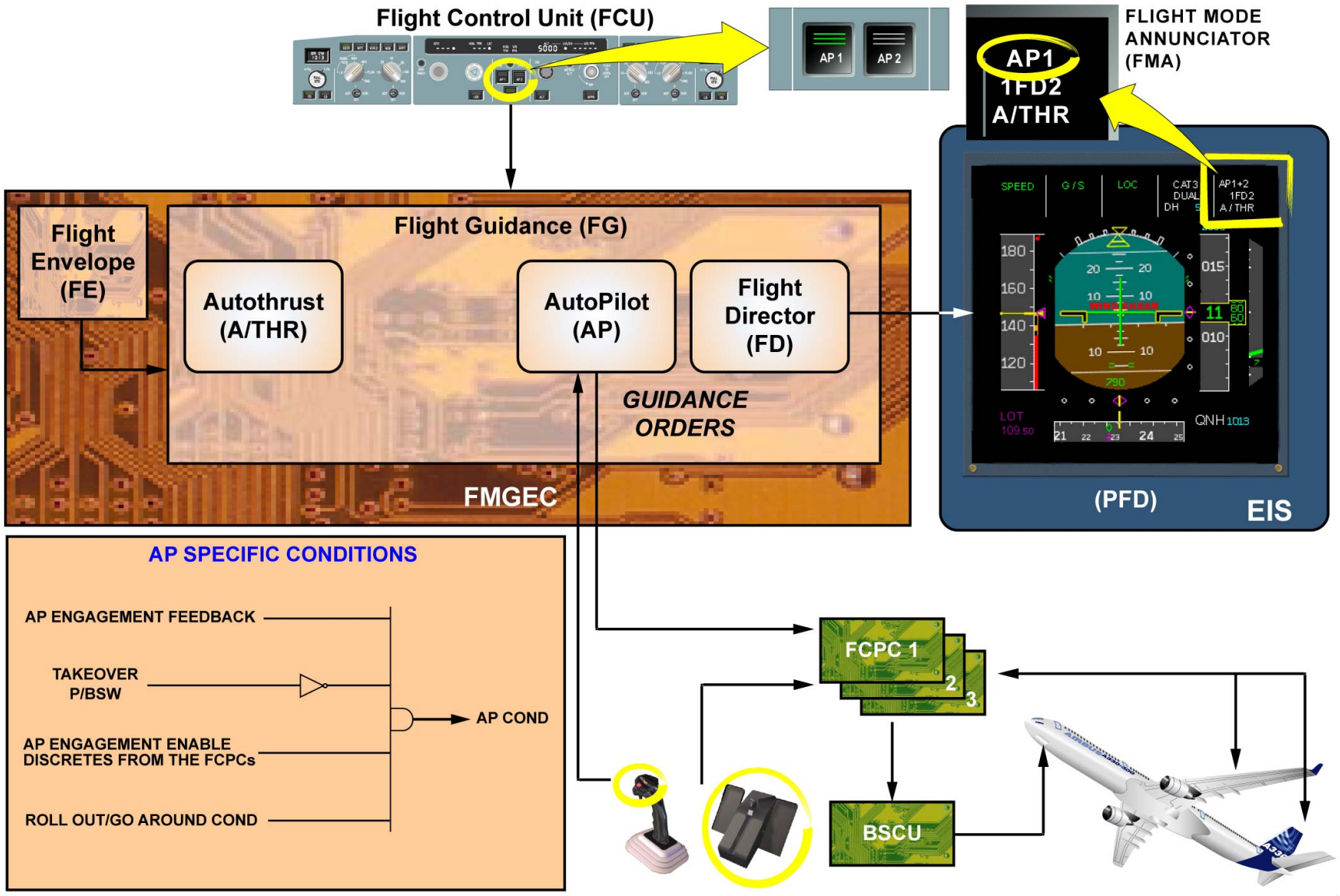

AUTOPILOT ENGAGEMENT

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FLIGHT GUIDANCE GENERAL DESCRIPTION (3)

AUTOTHRUST ENGAGEMENT

The autothrust engagement is done either automatically or manually:
- automatically when in take-off or go around phases, or when alpha floor protection is activated,
- manually through a dedicated FCU P/B.

When autothrust is engaged:
- the FCU A/THR pushbutton is lit,
- the engagement status is displayed on the FMA.

When engaged, the autothrust can be active or not depending on the position of the thrust levers. When engaged and not active, the thrust control is manual. The thrust is commanded according to the position of the thrust levers. When engaged and active, the thrust control is automatic, and the thrust is commanded according to the autothrust computed thrust target.

A/THR disengagement can be done manually:
- by pressing the autothrust instinctive disconnect switch on any thrust lever,
- by setting all thrust levers to idle position,
- through the dedicated FCU pushbutton.

The A/THR is disengaged automatically in case of failure detection.

The A/THR function can be engaged according to the following the AP, FD and A/THR common conditions and some specific conditions. The common condition are the following:
- the power must be supplied to the FMGEC for more than 3 seconds,
- the FM part must be valid to engage the cruise modes, but is not used for G/S TRACK below 700 ft, LAND TRACK and Go Around,
- if the two FM parts of the FMGEC 1 and 2 are lost, the AP/FD can be engaged only by using selected modes.

The specific conditions are the following:
- at least 2 ADIRUs valid except in alpha floor condition,
- two Engine Interface and Vibration Monitoring Units (EIVMU) must be healthy if both engine are running on A330 aircraft (one otherwise),
- three EIVMUs must be healthy on A340 aircraft,
- four Engine Electronic Controllers (EEC) / Electronic Control Unit (ECU) must be healthy.

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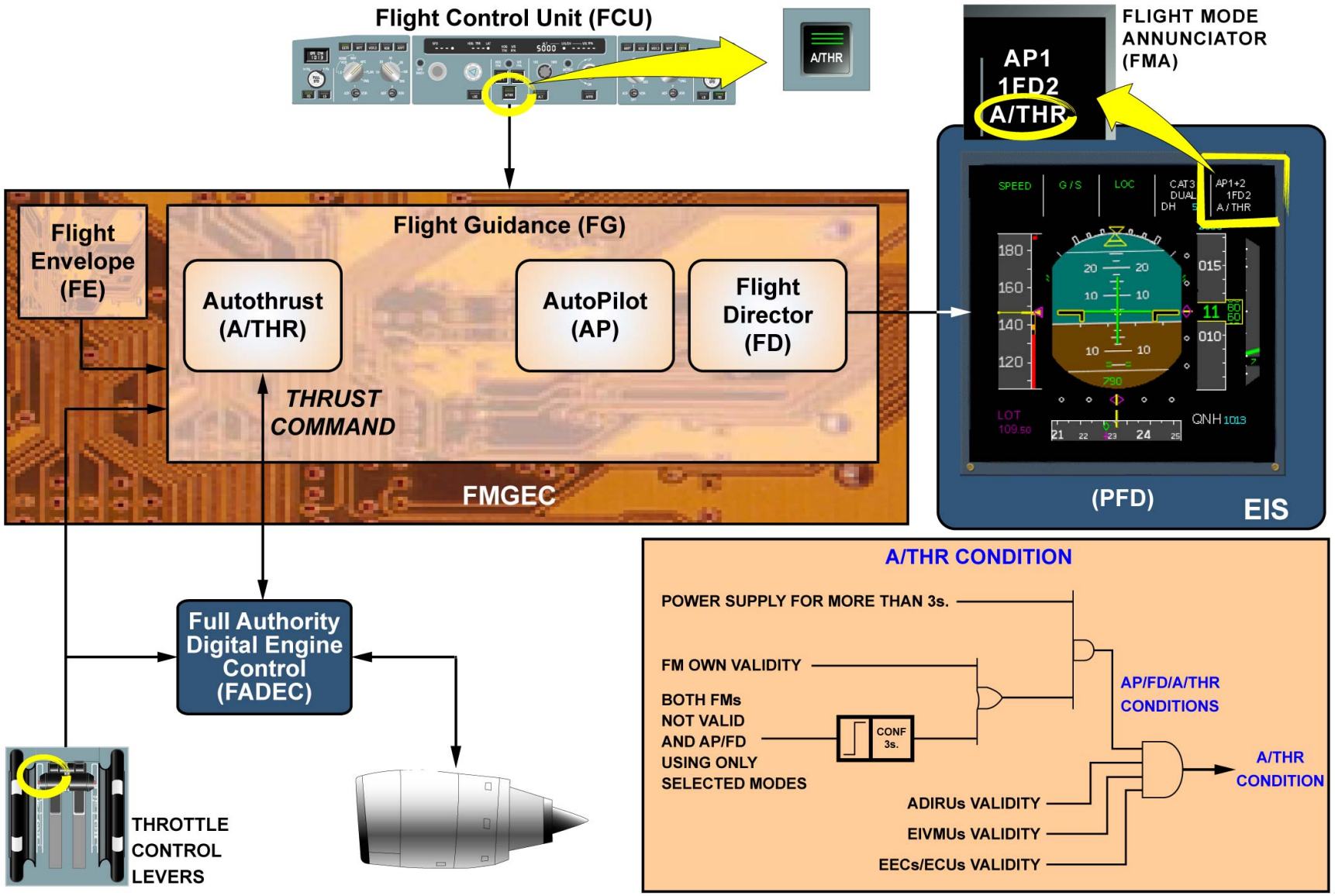

AUTOTHRUST ENGAGEMENT

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FLIGHT GUIDANCE GENERAL DESCRIPTION (3)

SPEED CONTROL

In flight, the speed is a safety parameter used as a reference for the longitudinal guidance. As a consequence, the FG functional part continuously controls the Speed/Mach parameter either by the AP/FD longitudinal guidance or the autothrust. The reference speed is always limited by the FE characteristic speeds computation. It is displayed on the speed scale of the PFDs.
The speed reference is computed by the FM functional part by pushing the FCU knob in, this is called "managed speed". If the speed reference comes from the FCU, by pulling the corresponding knob out, it is called "selected speed".

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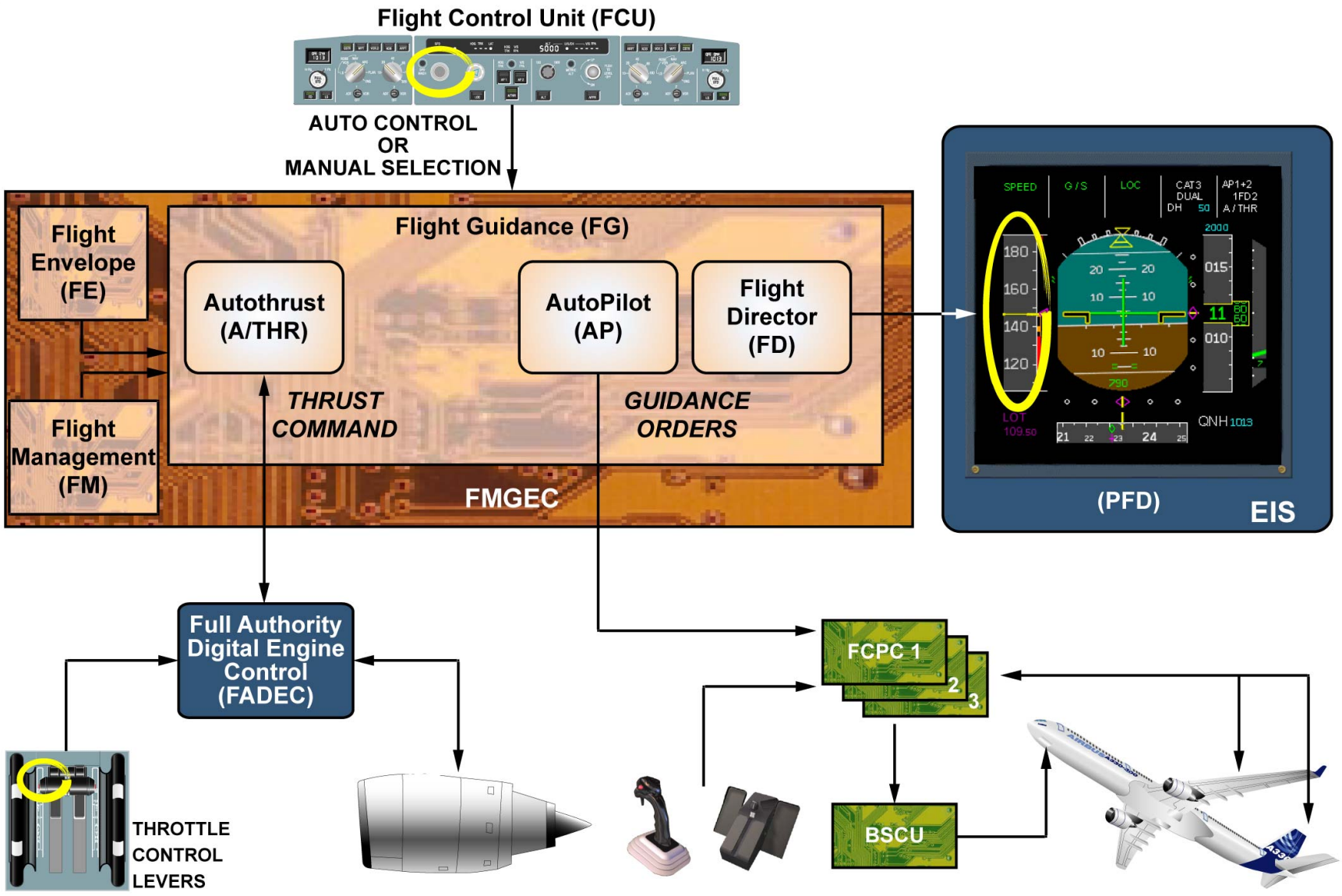

SPEED CONTROL

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FLIGHT GUIDANCE GENERAL DESCRIPTION (3)

LANDING CAPABILITY COMPUTATION

Each FMGEC computes the landing capability (CAT1 / CAT2 / CAT3 / SINGLE/CAT3 DUAL) during the whole flight:
- when the AP and FD are disengaged for one FMGEC, the landing capability corresponds to the category of the available FMGEC.
- when AP and FD are engaged for both FMGECs, the landing capability corresponds to the lowest category sent by the FMGECs.

The computation depends on Auto Flight System (AFS) and peripheral systems availability. The validity of the different systems used depends on the AFS components, the ADIRUs (ADR and IR parts), the Flight Warning Computers (FWC), the BSCU, the Electrical Flight Control System (EFCS), the RA, the ILS and the PFD. Some other conditions are also used (power supply splitting, etc). The landing capability availability is displayed on the ECAM STATUS page and, when in approach, on the fourth column of the FMA. Depending on the availability of peripherals, the landing capability can be downgraded. A triple click aural warning is generated if landing capability is downgraded.

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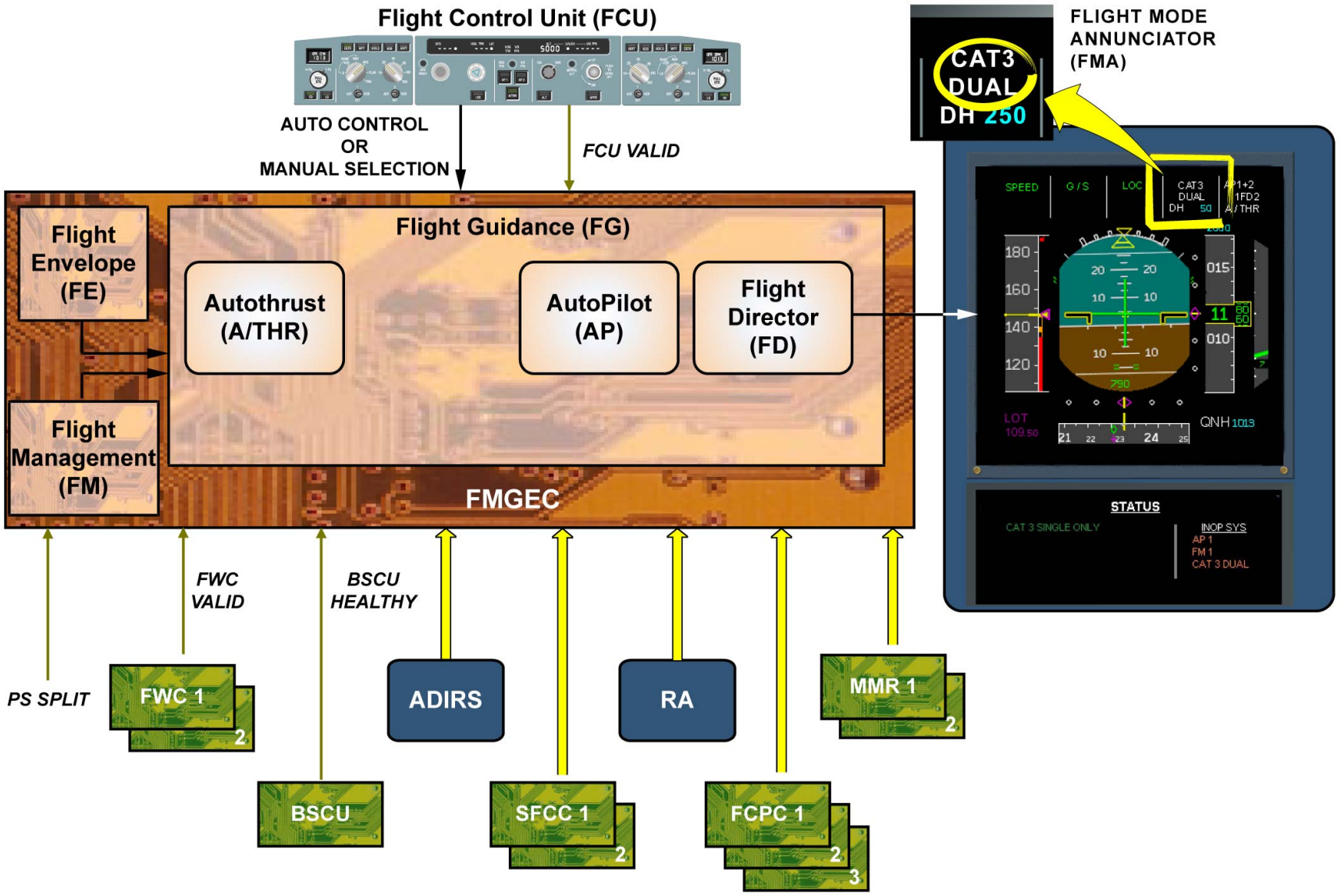

LANDING CAPABILITY COMPUTATION

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FLIGHT GUIDANCE AUTOTHRUST D/O (3)

ENGAGEMENT

MANUAL ENGAGEMENT

The engagement of the autothrust function can be manual or automatic. The autothrust is engaged manually by pressing the A/THR P/B on the Flight Control Unit (FCU). This is inhibited below 100 feet Radio Altimeter (RA), with engines running.

NOTE: Note that to effectively have autothrust on engines, the engagement of the autothrust is confirmed by a logic of activation in the Engine Electronic Controller (EEC) for Pratt & Whitney and Rolls Royce Engines and in the Engine Control Unit (ECU) for General Electrics (GE) engines.

AUTOMATIC ENGAGEMENT

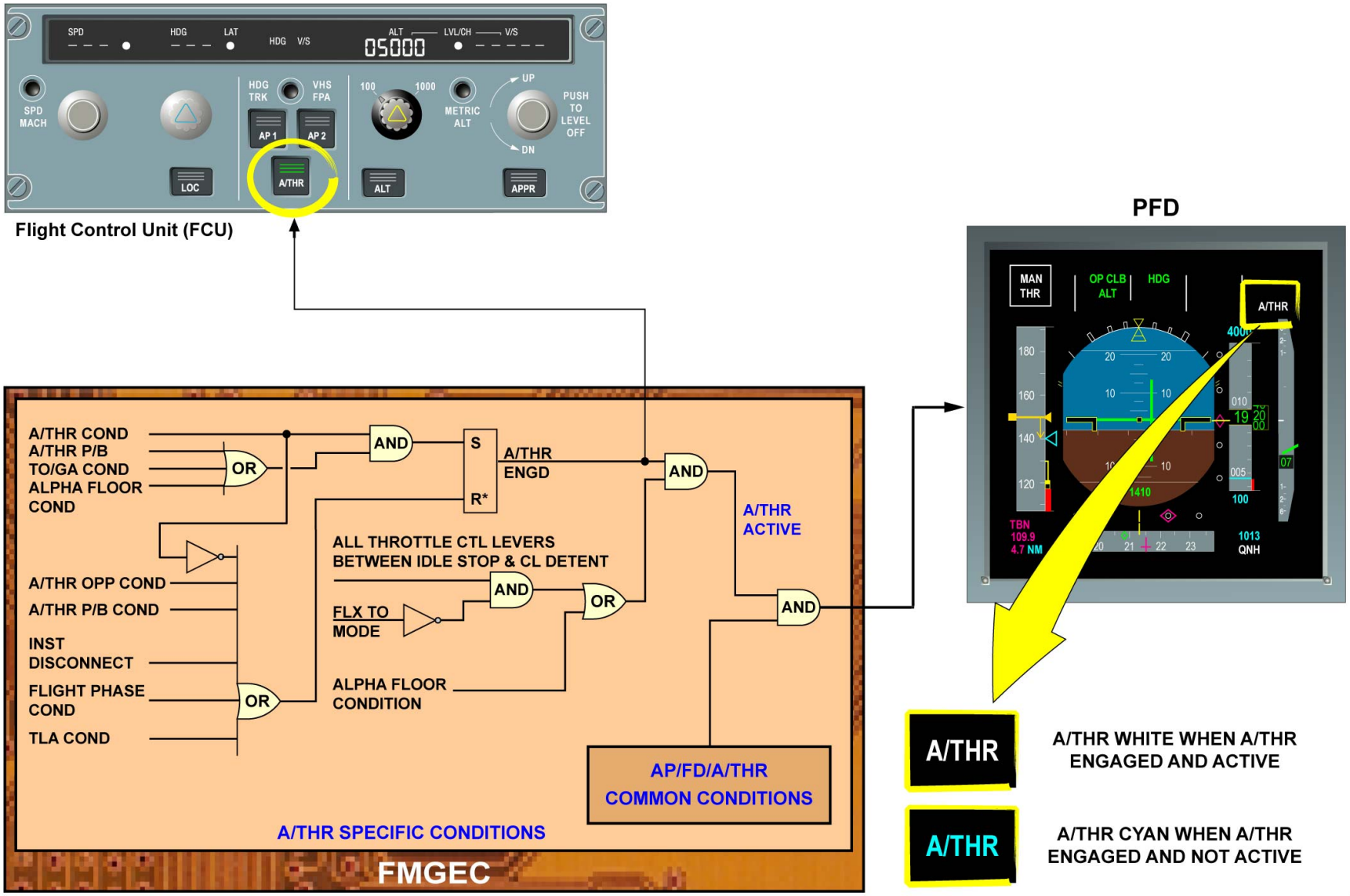
The autothrust is engaged automatically:
- when the Autopilot/Flight Director (AP/FD) modes are engaged at take-off or go-around,
- in flight, when the alphafloor (protection against high angle-of-attack) is activated; this is inhibited below 100 feet RA except during the 15 seconds following the lift-off.

A/THR CONDITIONS

The A/THR engagement is effective only when all the necessary conditions are met and if a request for engagement (pilot action or automatic) is present. Two conditions are required to make the engagement possible:
- AP/FD/A/THR common conditions,
- A/THR specific conditions.

The AP/FD/A/THR common conditions are the following:
- power must be supplied to the Flight Management Guidance and Envelope Computer (FMGEC) for more than 3 seconds,
- the Flight Management (FM) functional part of the FMGEC must be valid to engage the cruise mode. If the two FM functional part of the FMGECs 1 and 2 are lost, the AP/FD can be engaged only by using selected modes.

The conditions specific to the A/THR system includes the following conditions:
- the Flight Guidance and Envelope (FGE) functional parts must receive two valid Air Data/Inertial Reference Units (ADIRU),
- two Engine Interface and Vibration Monitoring Units (EIVMU) must be healthy,
- two EECs / ECUs must be healthy,
- the FCU must be healthy,
- no action on one of the A/THR instinctive disconnect P/BSW lasts more than 15 s, otherwise the A/THR engagement becomes impossible until the next FMGEC and EEC/ECU reset.



ENGAGEMENT - MANUAL ENGAGEMENT ... A/THR CONDITIONS

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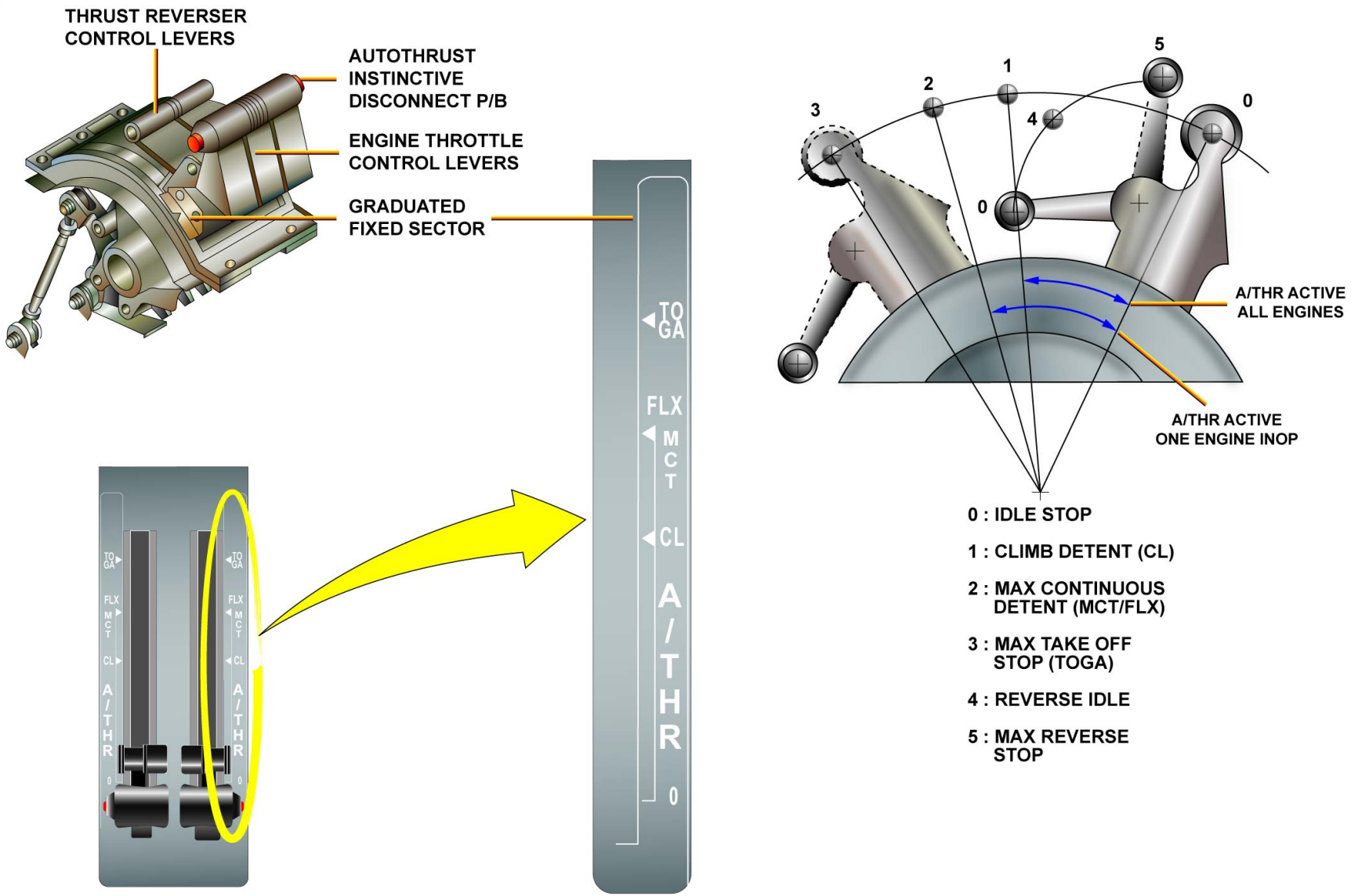
FLIGHT GUIDANCE AUTOTHRUST D/O (3)

THRUST LEVERS

The thrust levers are manually operated and electrically connected to the EECs/ECUs. Each lever has 4 positions, defined by detents or stops, and 3 operating segments. The EECs/ECUs compute the thrust limit, which depends on the position of the thrust levers. The A/THR can be active only between IDLE and CLB if all engines are operative and between IDLE and FLX/MCT with one engine INOP.

NOTE: Note: The thrust levers never move automatically.
The thrust levers can be moved on a sector, which includes specific positions:
- 0: corresponds to an idle thrust,
- CL: corresponds to the maximum climb thrust or derated climb thrust,
- FLX/MCT / DTO: corresponds to a Flexible Take-Off Thrust or a Maximum Continuous Thrust or Derated Take-Off thrust,
- TO/GA: corresponds to a maximum Take-Off (Go-Around) thrust.
The Thrust Reverser (T/R) levers only allow reverse thrust to operate.)..
If a thrust lever is in a detent, the thrust limit agrees with this detent. If a thrust lever is not in a detent, the thrust limit agrees with the next higher detent. The FMGECs select the higher of the EEC/ECU 1 and EEC/ECU 2 thrust limits.



THRUST LEVERS

G9409341 - GAUT0T0 - FM22D3F22GK0103

FLIGHT GUIDANCE AUTOTHRUST D/O (3)

A/THR LOOP PRINCIPLE

To apply the autothrust function, the master FMGEC communicates with the Full Authority Digital Engine Control (FADEC) via the FCU and the EIVMUs.

A/THR FUNCTION LOGIC

The autothrust function can be engaged or disengaged. When it is engaged, it can be active or not active.

A/THR FUNCTION DISENGAGED

When the autothrust function is disengaged:
- the thrust levers control the engines,
- on the FCU, the A/THR P/B light is OFF,
- the Flight Mode Annunciator (FMA) does not display the autothrust engagement status nor the autothrust modes.

A/THR FUNCTION ENGAGED

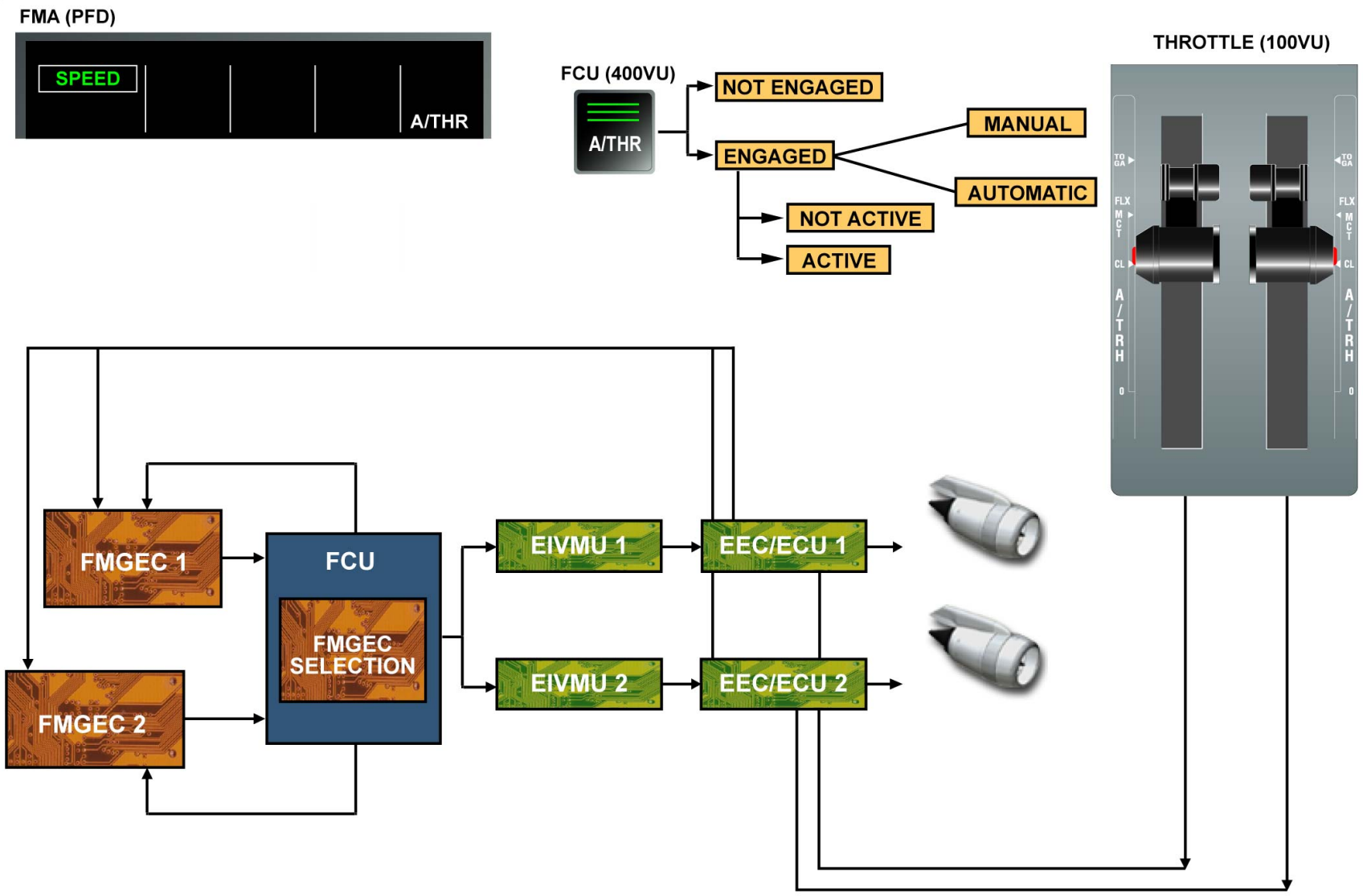
When the autothrust engagement logic conditions are present, the autothrust can be engaged. It is active or not active depending on the thrust lever position.
Autothrust is active if:
- at least, one thrust lever is between CL detent (included) and 0 stop (included) and, at the most, one thrust lever is between the MCT detent and CL detent, and if there is no engine in FLEX TO mode,
- the alphafloor protection is active.

When the autothrust function is engaged and active:
- the autothrust system controls the engines,
- on the FCU, the A/THR P/B light is ON,
- the FMA displays the autothrust engagement status (in white in the right column) and the autothrust mode in the left column.

A/THR is not active if:
- at least, one thrust lever is above the MCT detent or, all the thrust levers are above the CL detent or, at least one engine is in FLEX TO mode,
- the alphafloor protection is not active.

When the autothrust function is engaged and not active:
- the thrust levers control the engines (as long as a thrust lever is outside the autothrust active area),
- the A/THR P/B light is ON,
- the FMA displays the autothrust engagement status (in cyan in the right column) and the thrust setting in the left column.

NOTE: In case of engine failure, the A/THR activation zones become between the MCT and 0 stops.



A/THR LOOP PRINCIPLE & A/THR FUNCTION LOGIC

FLIGHT GUIDANCE AUTOTHRUST D/O (3)

MODES

The autothrust function works according to modes and their related reference parameters. The reference parameters can be:
- a SPEED or a MACH NUMBER: in this case, the source is either the FCU (value chosen by the pilots) or the FMGEC itself.
- a THRUST; in that case, the sources are either the EECs / ECUs (which compute the thrust limit) when the thrust limit is needed, or the FMGEC itself.

The possible autothrust modes are SPEED, MACH, THRUST, RETARD and alphafloor protection.

MODES DESCRIPTION

The choice of the mode is made by the FMGECs according to the AP/FD current longitudinal active mode:
- SPEED or MACH mode, the reference of which is selected on the FCU or managed by the FMGEC,
- THRUST mode, where the reference agrees with the thrust limit computed by the EECs/ECUs (according to the thrust lever position), idle thrust in descent or optimum thrust computed by the FMGEC,
- RETARD mode: the thrust is reduced and maintained at idle during flare,
- ALPHAFLOOR PROTECTION: a TO/GA thrust is activated to protect the A/C against excessive angle-of-attack and windshear.

DEFAULT MODE

When no longitudinal mode is active, the A/THR operates in SPEED/MACH modes except:
- when THRUST mode engages automatically in case of alphafloor protection activation,
- when, autothrust being in RETARD, APs and FDs disengage, the autothrust function remains in RETARD mode.

ALPHAFLOOR

The autothrust function protects against an excessive angle-of-attack.
The alphafloor detection is ensured by each Flight Control Primary Computer (FCPC). In case of excessive angle-of-attack, the FCPCs send a detection signal to the FMGECs, which activates the alphafloor protection.
The alphafloor protection automatically engages and activates the autothrust function, whatever the position of the thrust levers and the A/THR engagement status: the engine thrust becomes equal to TO/GA thrust.
When the autothrust is active with the alphafloor protection active, a green message "A.FLOOR" surrounded by a flashing amber box is displayed on the FMA.
When the autothrust is active with the alphafloor protection active but with the alphafloor detection no longer present in the FCPCs, a green message "TOGALK" (LK for LOCK) surrounded by a flashing amber box is displayed on the FMA.
The "TOGALK" thrust can only be cancelled through the disengagement of the autothrust function, via the A/THR P/B or the autothrust instinctive disconnect switches.

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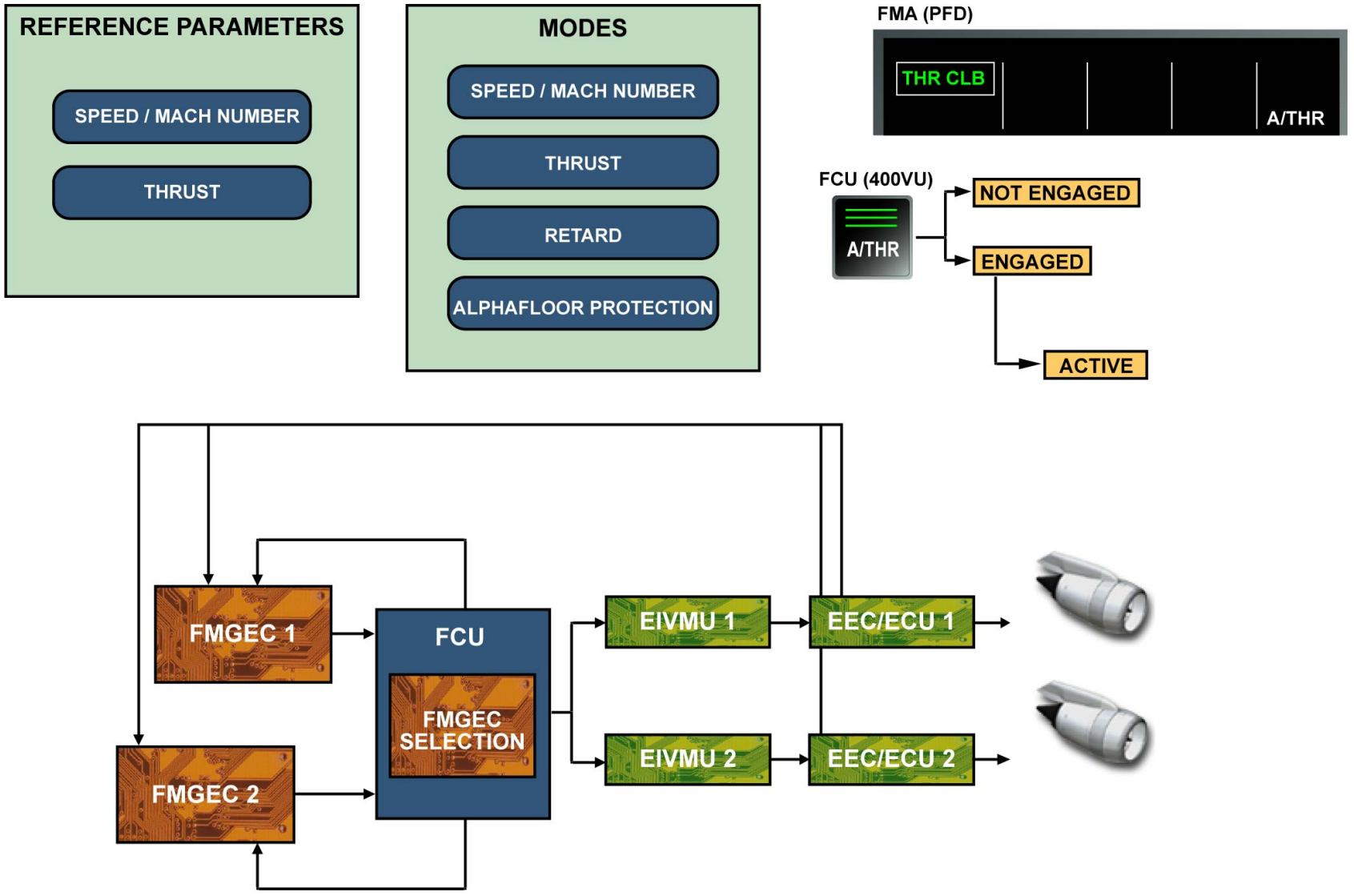

MODES & ALPHAFLOOR

FLIGHT GUIDANCE AUTOTHRUST D/O (3)

A/THR OPERATION IN FLIGHT

Let's now see the autothrust operation in flight.

TAKE-OFF

The A/C is on ground and ready for take-off, the engines are controlled by the thrust levers and neither AP nor autothrust are engaged. To take off, the pilot sets the thrust levers to the TO/GA stop, or to the FLX/MCT detent provided a flexible temperature was previously selected on the MCDU. This engages the autothrust function (but it is not active).

THRUST REDUCTION ALTITUDE

At thrust reduction altitude, a message on the FMAs warns the pilots to set the thrust levers in the CL detent. As soon as the thrust levers are in the CL detent, the autothrust is active. If a thrust lever is set into the CL - MCT area, a message on the FMAs warns the pilot to set the thrust lever to the CL detent (LVR CLB). The autothrust remains active. Then, the thrust levers remain in this position until the approach phase.

AUTOMATIC LANDING

During AUTOMATIC LANDING, before touch-down, an auto call-out, "RETARD", warns the pilot to set the thrust levers to idle. When the pilot put both levers on idle detent, the autothrust disengages. This allows the automatic activation of the ground spoilers if they are in armed condition. Then, on GROUND, the pilot sets the T/R levers to the reverse position.

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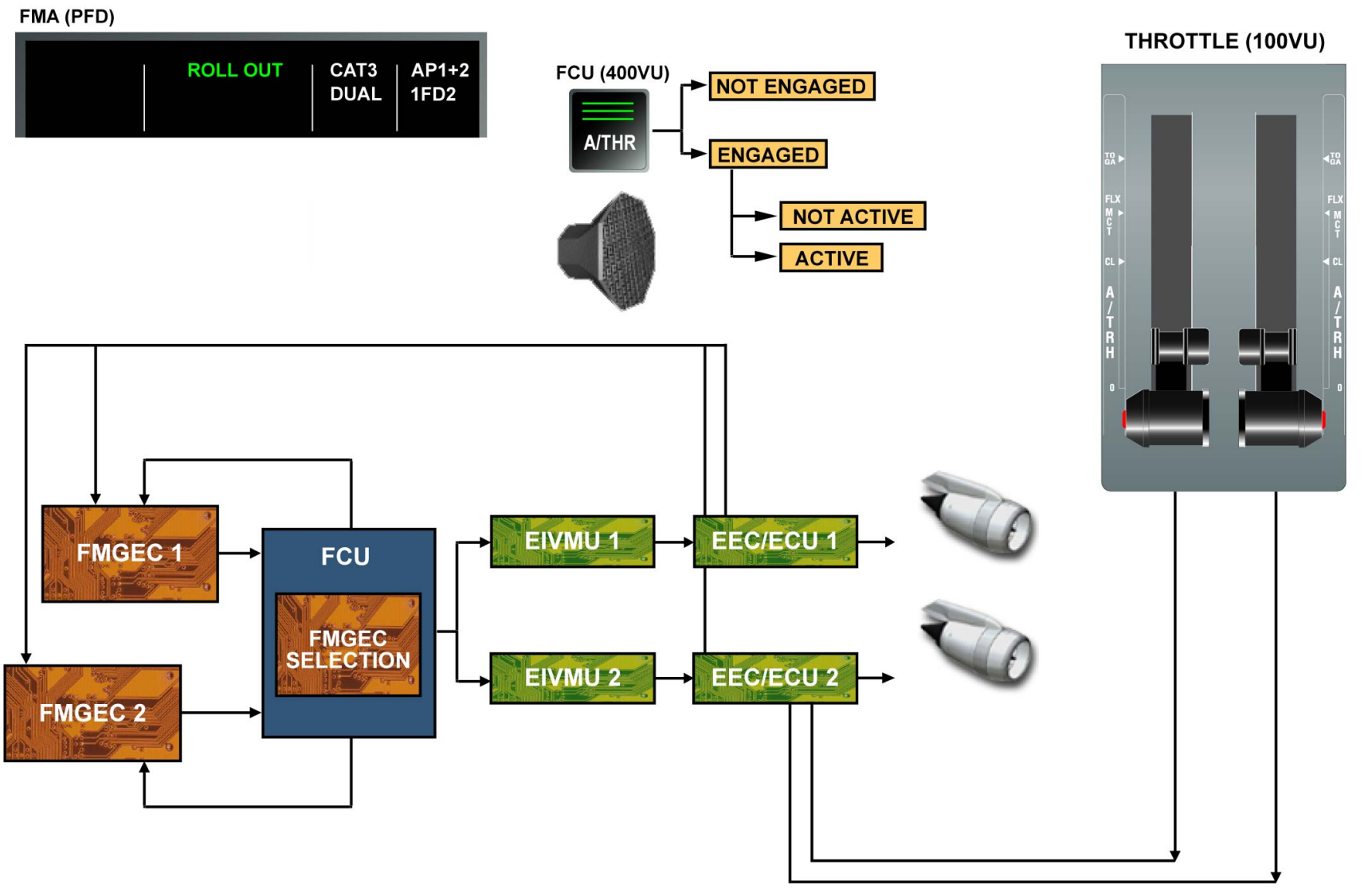


A/THR OPERATION IN FLIGHT - TAKE-OFF ... AUTOMATIC LANDING

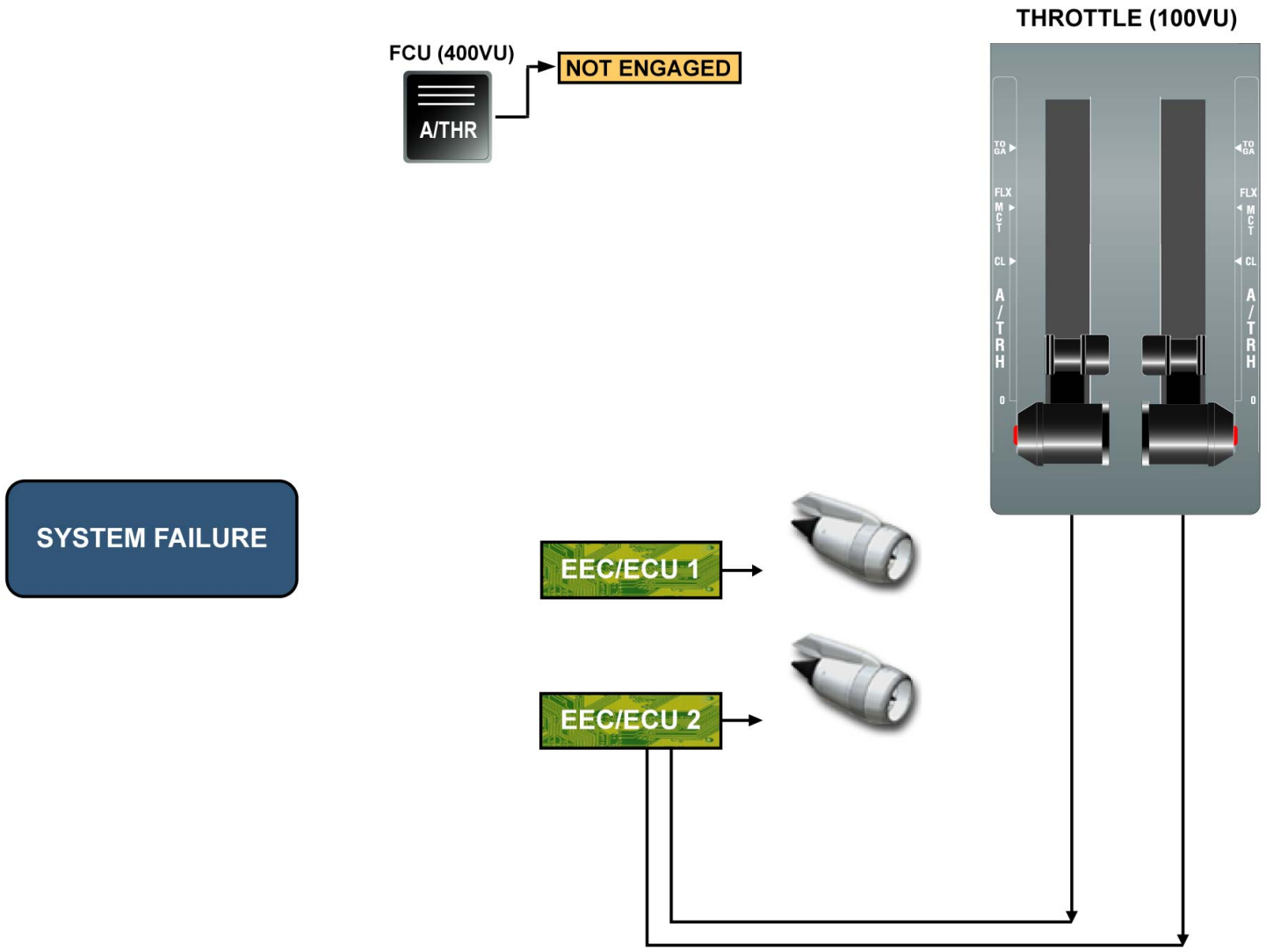
FLIGHT GUIDANCE AUTOTHRUST D/O (3)

DISCONNECTION

The autothrust can be disengaged in two ways.
- standard disconnection: By pressing at least one of the two red instinctive disconnect switches on the side of thrust levers or setting all thrust levers to IDLE detent.
- non standard disconnection: By pressing the A/THR P/B on the FCU or failure mode affecting one of the engagement condition. When the autothrust function is active, the actual engine thrust does not necessarily agree with the thrust lever position.

DISCONNECTION CONSEQUENCES

It is important to know what happens after autothrust disconnection.
When the autothrust function is disengaged through the instinctive disconnect switches, or setting the levers on IDLE, the thrust on the engines is automatically adapted to the related thrust lever position.
When the autothrust function is disengaged through the FCU A/THR P/B or due to a system failure:
- as long as a thrust lever remains in its detent, the thrust on the related engine is frozen at its last value just before the disconnection,
- as soon as a thrust lever is moved from the detent, or if it was not in a detent, the thrust on the related engine is smoothly adapted to the thrust lever position.



DISCONNECTION - DISCONNECTION CONSEQUENCES

FLIGHT GUIDANCE PRIORITY LOGIC D/O (3)

FLIGHT GUIDANCE (FG)

The engagement status of the guidance function works on the MASTER/SLAVE principle. The master Flight Management Guidance and Envelope Computer (FMGEC) imposes all the changes of AP/Flight Director (FD) modes and/or A/THR engagement to the slave FMGEC. Here is an example of a master FMGEC. Look at the flow chart to understand the priority logic. With no AP, no FD1 but FD2 engaged, FMGEC2 is the master because, following the flow chart, the first three answers are "NO", but the fourth one is "YES".

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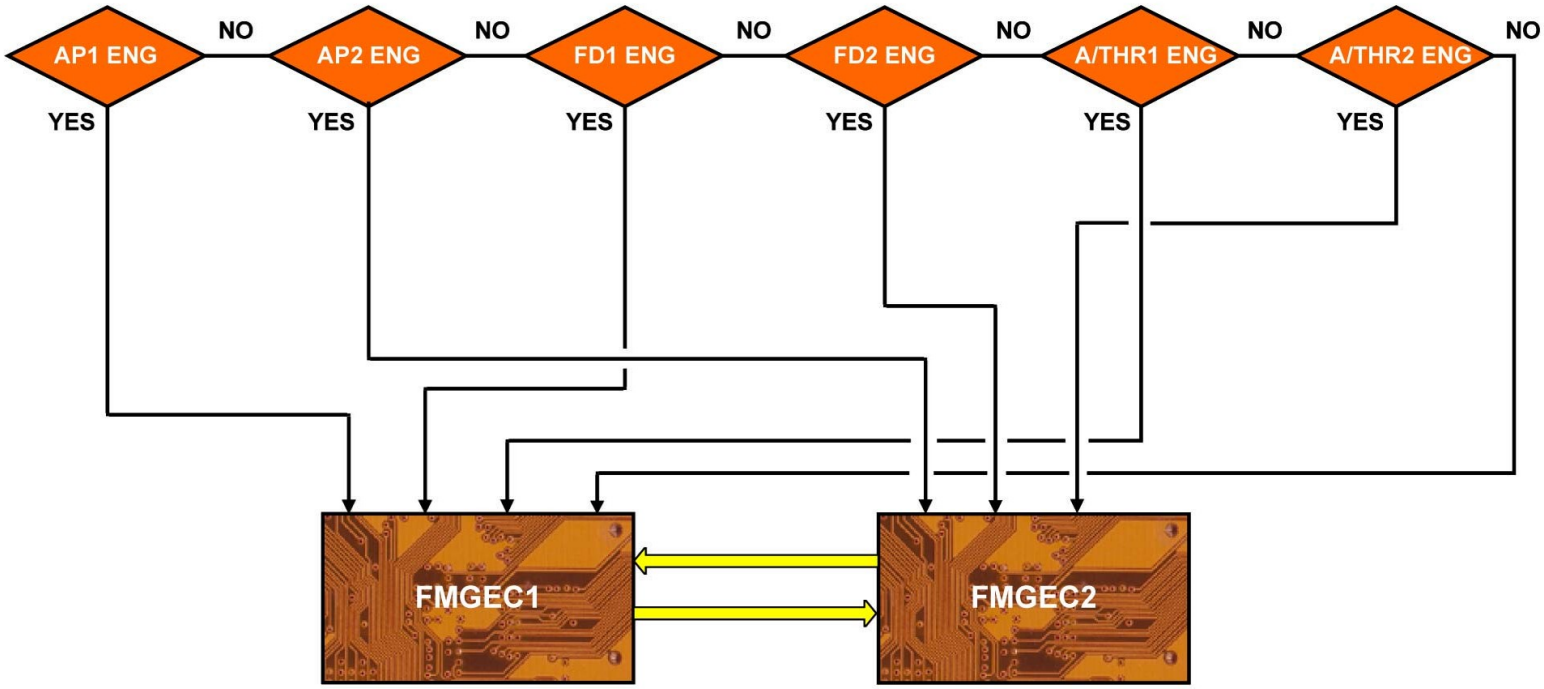
GUIDANCE FUNCTION: ENGAGEMENT STATUS



- A/THR: AUTOTHRUST
- AP: AUTO PILOT
- FD: FLIGHT DISPLAY
- FMGEC: FLIGHT MANAGEMENT GUIDANCE AND ENVELOPE COMPUTER

FLIGHT GUIDANCE (FG)

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FLIGHT GUIDANCE PRIORITY LOGIC D/O (3)

FLIGHT DIRECTOR (FD)

Upon energization, both FDs are normally engaged in split configuration.
FMGEC1 normally drives the FD symbols (crossed bars or flight path director symbols) on the CAPT PFD. FMGEC2 normally drives the FD symbols on the First Officer (F/O) PFD. The "1FD2" indication is displayed on each Flight Mode Annunciator (FMA) to show that FD1 is engaged on the CAPT side and FD2 is engaged on the F/O side.
If one FMGEC fails, the remaining FMGEC drives the FD symbols on both PFDs. If FMGEC1 fails, the "2FD2" indication is displayed on each FMA to show that FD2 is displayed on both PFDs.
If both FDs fail, a red flag is displayed on both PFDs, provided that the FD switch is still "ON".

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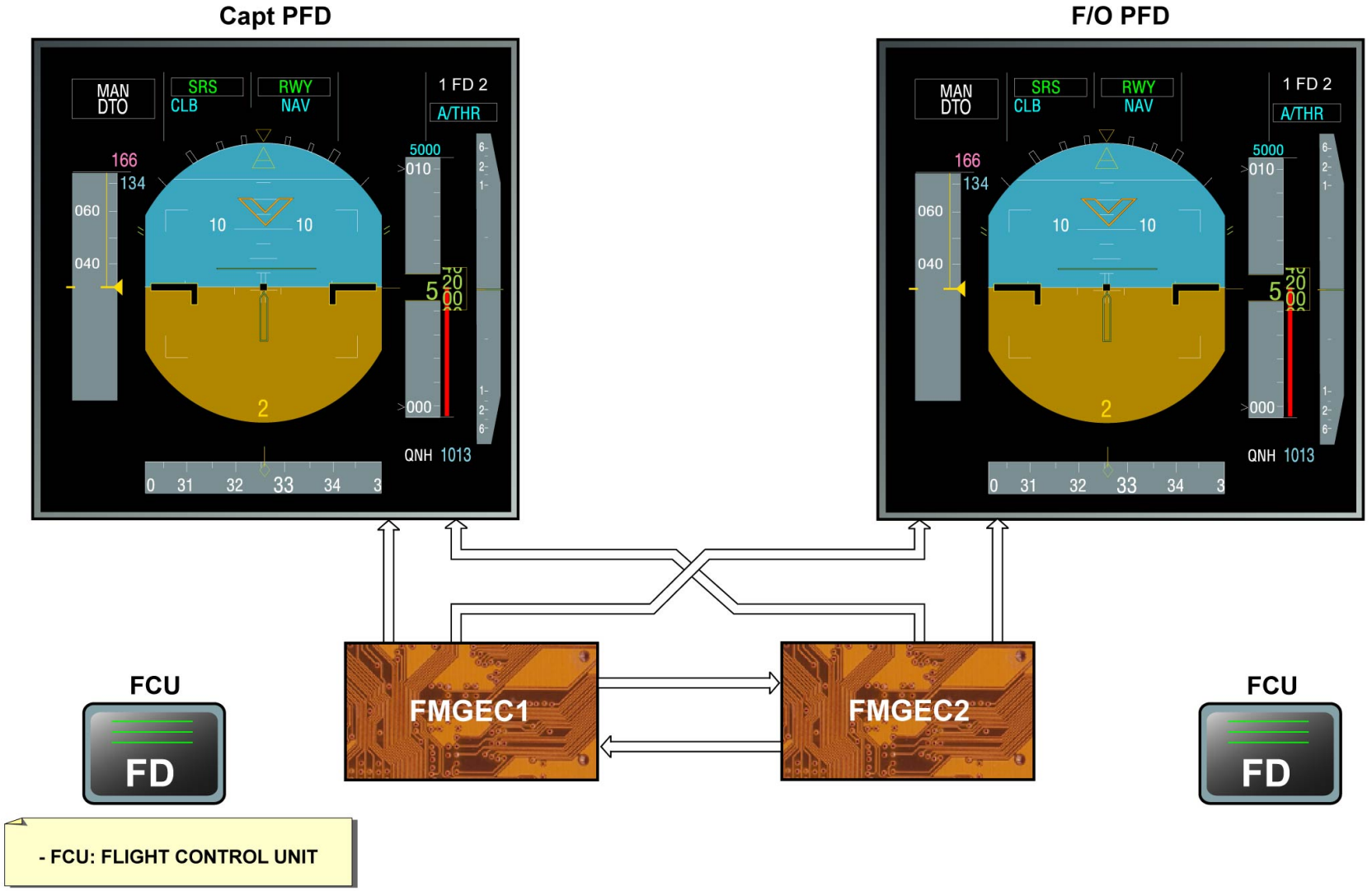
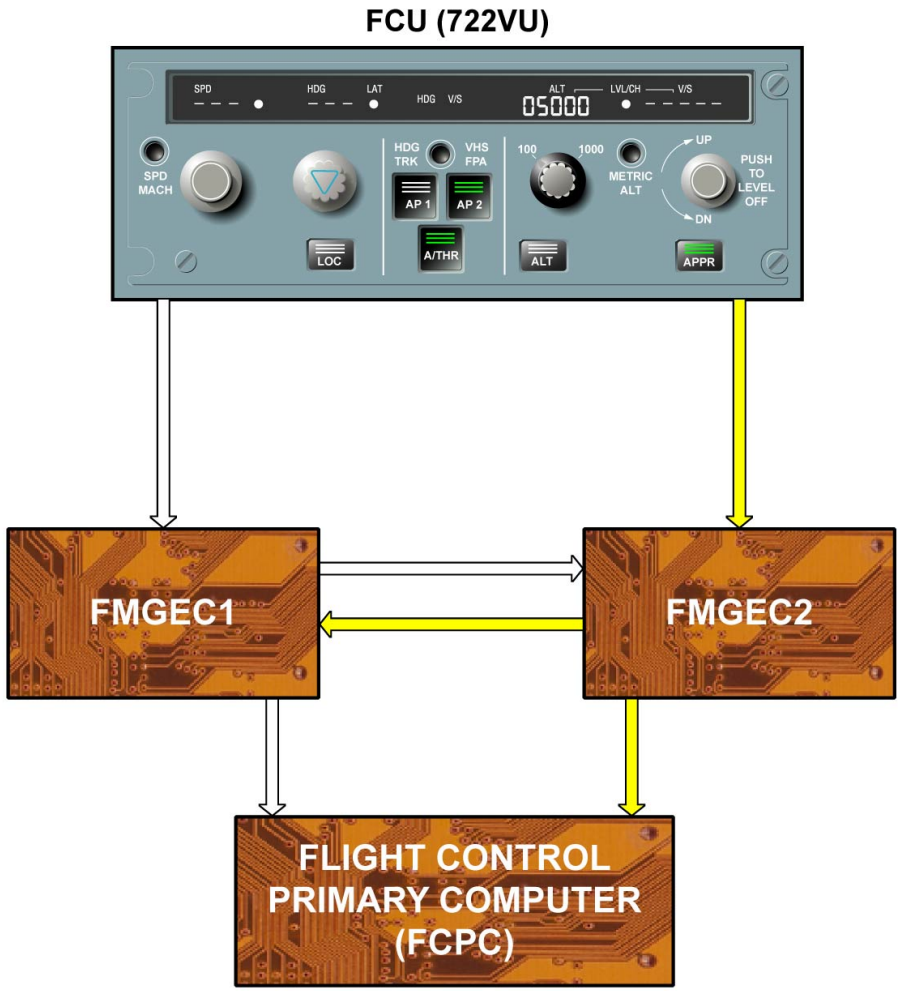


FLIGHT DIRECTOR (FD)

FLIGHT GUIDANCE PRIORITY LOGIC D/O (3)

AUTOPILOT (AP)

If one AP is engaged, the corresponding FMGEC send signals to the Flight Control Primary Computers (FCPCs), which will control the flight control surfaces.
There is no priority logic in single operation. The last engaged AP is the active one.
Both APs can be engaged as soon as the APPROACH mode is selected on the Flight Control Unit (FCU). AP1 has priority and AP2 is in synchronisation. This means the FCPCs use the AP1 commands first.
The FCPCs switch to the AP2 commands in case of AP1 disengagement.

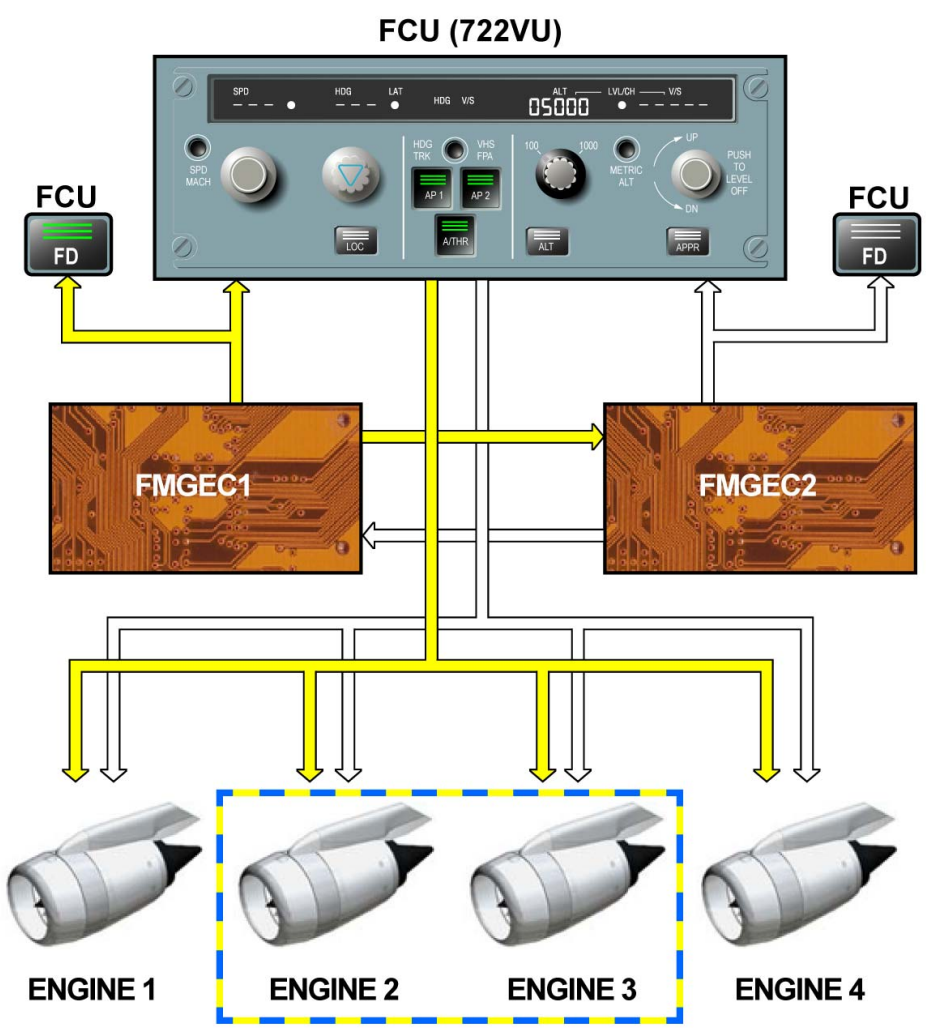


AUTOPILOT (AP)

FLIGHT GUIDANCE PRIORITY LOGIC D/O (3)

AUTOTHRUST (A/THR)

A single A/THR P/BSW located on the FCU enables the engagement or disengagement of the A/THR function.
The A/THR function is, in fact, composed of two systems (A/THR1 and A/THR2) which are ready to be engaged at the same time, but only one system is selected. However the selection of A/THR1 or 2 depends on the engagement of the AP and FD, i.e. of the master/slave principle which is known by the FCU and summarized in the table.
When the selected A/THR function is active (according to the thrust lever position), the master FMGEC sends signals via the FCU to the FADEC, which will control the engines. Consequently, in automatic control, it is the same FMGEC which will command orders both to the engines and the flight controls.
To recover the A/THR function, when one AP (AP1 or 2) is engaged and its own A/THR has failed, the opposite AP should be engaged to switch from the master FMGEC to the other (which now becomes the master) and to switch to the opposite A/THR.



ENGAGT OF AP		ENGAGT OF FD		A/THR ACTIVE
1	2	1	2	
ON	*	*	*	A/THR 1
OFF	ON	*	*	A/THR 2
OFF	OFF	ON	*	A/THR 1
OFF	OFF	OFF	ON	A/THR 2
OFF	OFF	OFF	OFF	A/THR 1, OR A/THR2 IF A/THR 1 FAILS

* ON or OFF

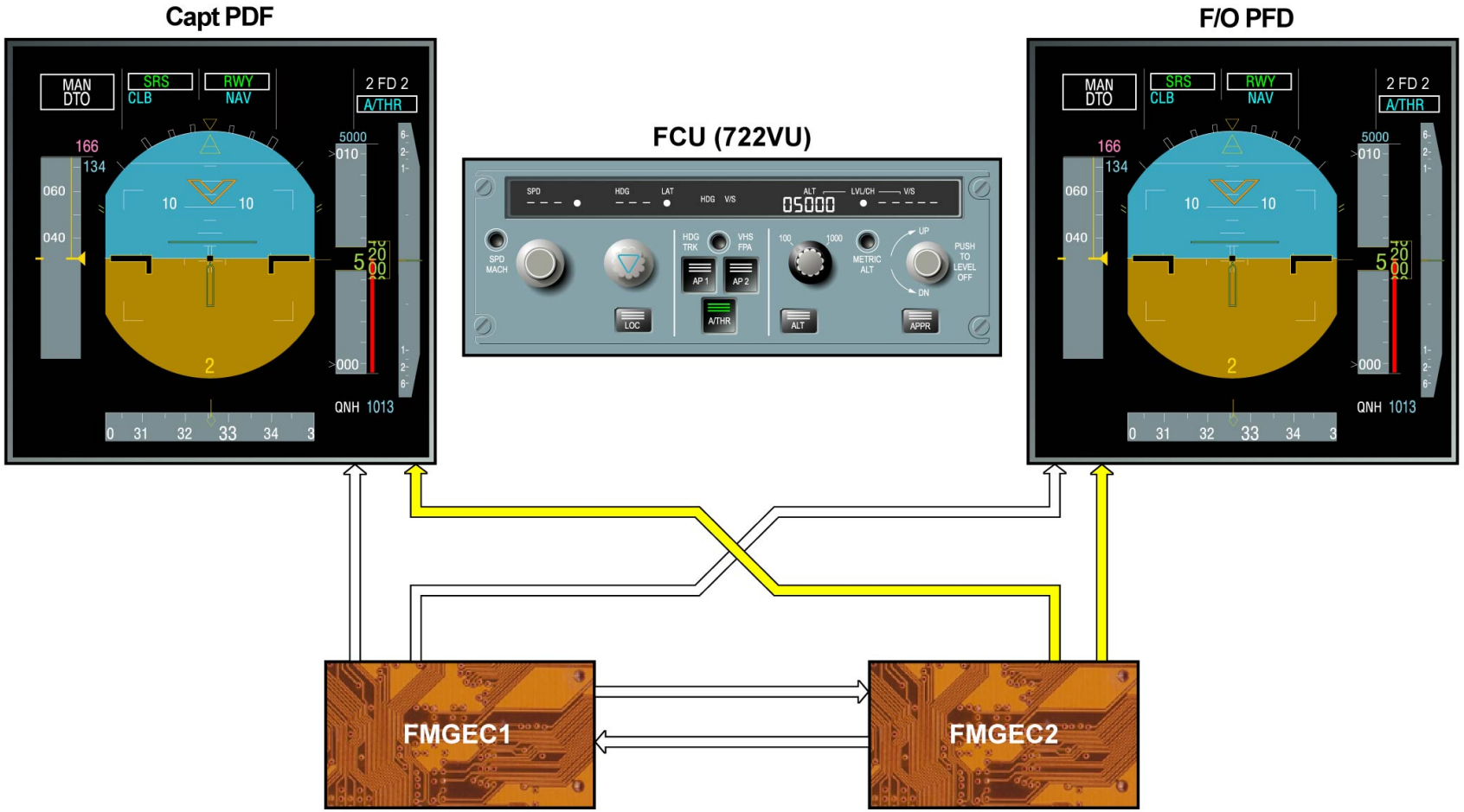
AUTOTHRUST (A/THR)

FLIGHT GUIDANCE PRIORITY LOGIC D/O (3)

FLIGHT MODE ANNUNCIATOR (FMA)

There are three types of information shown on the FMA:
- A/THR mode and status,
- AP/FD mode and status,
- Flight Management (FM) messages.

The A/THR information is displayed by the master FMGEC which supplies both FMAs.
The AP/FD information is displayed according to the following logic:
- with at least one AP, the master FMGEC supplies both FMAs,
- without AP, with the FDs engaged, FMGEC1 supplies FMA1, FMGEC2 supplies FMA2,
- without AP, with one FD failed or manually disengaged, the opposite FMGEC supplies both FMAs.



FLIGHT MODE ANNUNCIATOR (FMA)

FLIGHT GUIDANCE PRIORITY LOGIC D/O (3)

FLIGHT CONTROL UNIT (FCU)

The FCU ensures the interface between the crew and the following three systems:
- Automatic Flight System (AFS),
- EFIS left (including the baro-setting),
- EFIS right (including the baro-setting).

The FCU central processing unit consists of two identical computation channels B and C. In normal operating conditions, each computation channel performs a specific function as follows:
- channel B: EFIS LEFT and AFS,
- channel C: EFIS RIGHT.

In the event of a failure of one channel, there is reconfiguration on the remaining channel. This logic enables the maximum availability of FCU functions. Each channel receives all data required to ensure the three functions.

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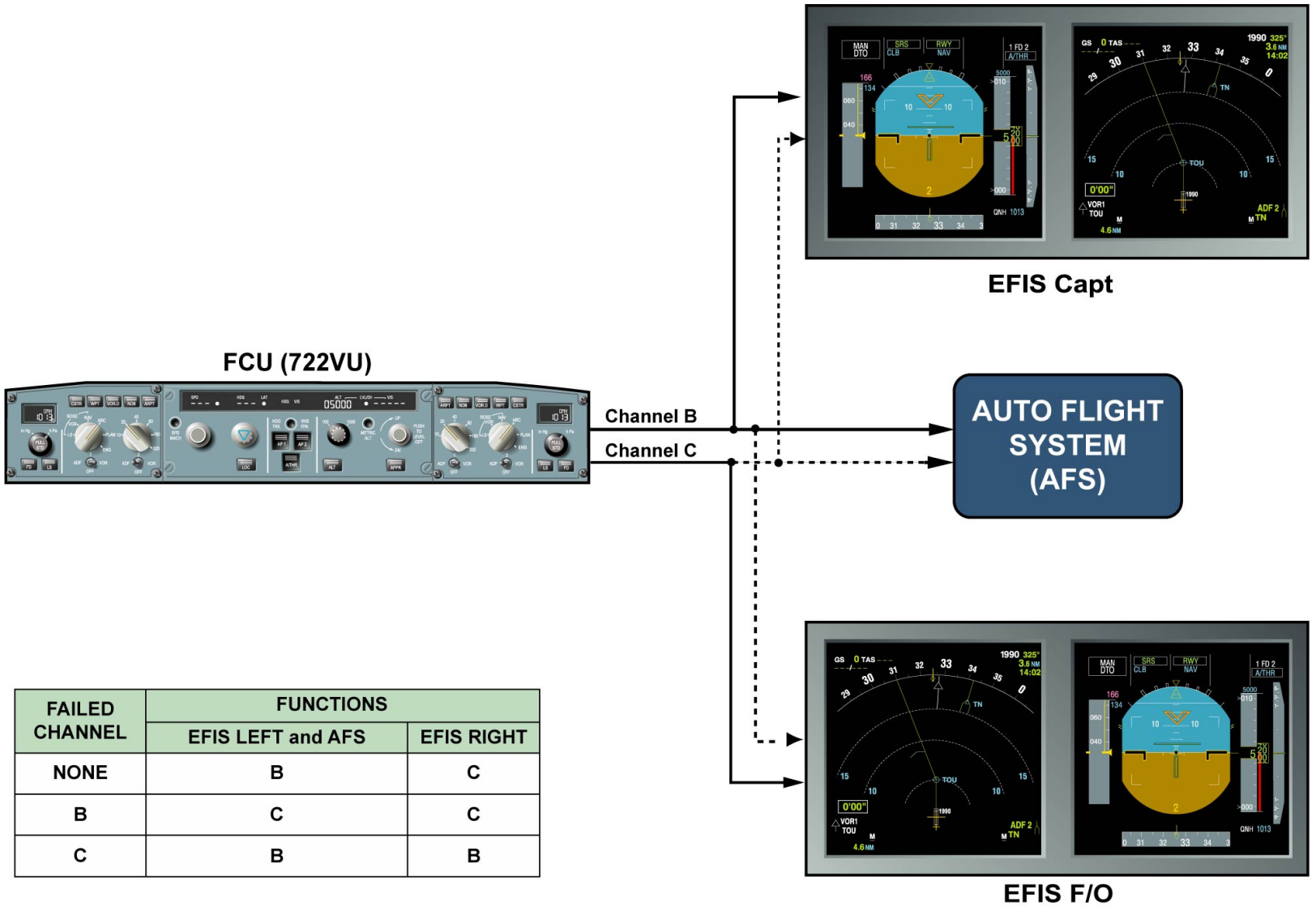

FAILED CHANNEL	FUNCTIONS	
	EFIS LEFT and AFS	EFIS RIGHT
NONE	B	C
B	C	C
C	B	B

FLIGHT CONTROL UNIT (FCU)

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AP/FD & ATHR MODES D/O (3)

AP/FD MODES

GENERAL

The operational use of the Automatic Flight System (AFS) is based on the following principle:
- the short-term pilot orders are entered through the Flight Control Unit (FCU),
- the long-term pilot orders are entered through the MCDU.

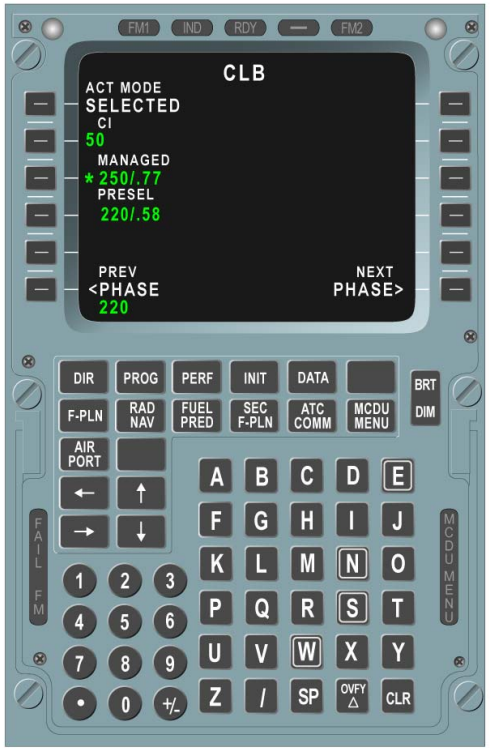
This principle leads to two types of Autopilot (AP)/Flight Director (FD) operating modes to guide the aircraft:
- the selected modes and,
- the managed modes.

In the selected modes, the pilot selects reference parameters on the FCU (heading/track, vertical speed/flight path angle, speed/Mach, altitude). To do this, the pilot turns the relevant selector knob on the FCU to set the parameter, and then pulls the knob.

In the managed modes, the Flight Management Guidance and Envelope Computer (FMGEC) uses data entered on the MCDU to compute the reference parameters. To set a parameter in the managed mode, the pilot pushes the relevant selector knob on the FCU. A dashed line on the FCU shows the managed mode (except altitude which is always displayed) and a white indicator light comes on adjacent to the display involved.

Flight Control Unit (FCU)

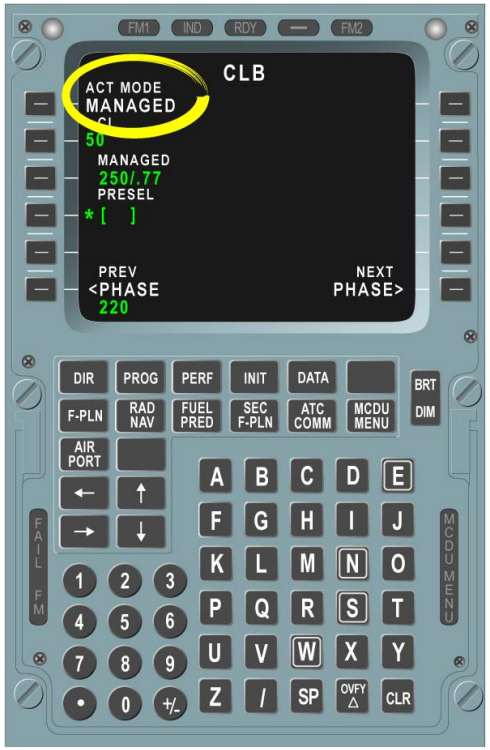
MCDU



AP/FD MODES - GENERAL

Flight Control Unit (FCU)

MCDU



AP/FD MODES - GENERAL

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AP/FD & ATHR MODES D/O (3)

AP/FD MODES (continued)

SELECTED MODES

In the selected modes, the pilot can engage the modes by pulling out the appropriate FCU selection knobs. There are two categories of AP/FD modes:
- vertical modes, which include the speed control modes,
- lateral modes.

The selected AP/FD lateral mode is the heading, track mode (HDG-TRK), also called basic mode. The selected AP/FD vertical modes are:
- Open Climb mode (OP CLB),
- Open Descent mode (OP DES),
- Vertical Speed mode (V/S) or Flight Path Angle (FPA) mode, also called basic modes,
- Altitude capture mode (ALT*),
- Altitude hold mode (ALT).

MANAGED MODES

At takeoff, the managed modes engage automatically when the pilot sets the thrust levers at the TO or FLX detent. During flight, the pilot can arm or engage the managed modes (if the aircraft meets engagement conditions) by pushing in the appropriate knobs on the FCU. The pilot pushes the DIR TO key on the MCDU to insert a DIR TO leg. It engages or maintains the navigation (NAV) mode. The pilot pushes the APPR P/B on the FCU to arm or engage the localizer (LOC) and Glide Slope (G/S) or APP NAV-FINAL, according to the approach type inserted in the flight plan. The LOC P/B arms or engages only the LOC mode.

The managed AP/FD lateral modes are:
- NAV mode (NAV),
- Approach Nav mode (APP NAV),
- Localizer capture mode (LOC*),
- LOC track mode (LOC)
- LOC Back Course mode (LOC B/C)
- Runway (RWY) or Runway Track mode (RWY TRK),
- Go Around Track mode (GA TRK),
- Roll out mode. (ROLL OUT).

The managed AP/FD vertical modes are:
- SRS mode (SRS) used for takeoff and Go-Around,
- Climb mode (CLB),
- Descent mode (DES),
- Altitude capture mode (ALT*),
- Altitude hold mode (ALT),
- Altitude Constraint capture mode (ALT CST*),
- Altitude Constraint hold mode (ALT CST),
- G/S capture mode (G/S*),
- Glide slope mode (G/S),
- FINAL mode (non precision approach),
- FLARE mode (Autoland).

NOTE: Automatic approach, landing, takeoff and go-around are considered as managed modes because no parameters are entered through the FCU.

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Flight Control Unit (FCU)

GUIDANCE	MANAGED MODES	SELECTED MODES
LATERAL	NAV, APP NAV B/C*, B/C, LOC*, LOC RWY RWY TRK GA TRK ROLL OUT	HDG - TRK
VERTICAL	SRS (T.O and G.A) CLB, DES ALT*, ALT ALT CSTR*, ALT CSTR G/S*, G/S FINAL, FLARE	OP CLB, OP DES V/S, FPA ALT*, ALT
SPEED	FMGC REFERENCE (ECON, Auto SPD, SPD LIM)	FCU REFERENCE

AP/FD MODES - SELECTED MODES & MANAGED MODES

AP/FD & ATHR MODES D/O (3)

A/THR MODES

GENERAL

The A/THR mode selection is automatic according to AP/FD mode engagement. The thrust control mode directly depends on the AP/FD vertical guidance mode. If no AP/FD is engaged, the A/THR can be engaged in SPD/MACH mode. The alpha floor protection commands the maximun takeoff thrust whatever the A/THR engaged mode.

SPD/MACH MODE

In SPEED/MACH mode, the A/THR adjusts the thrust in order to acquire and hold a speed or Mach target. The speed or Mach target may be:
- selected on the FCU by the pilot,
- managed by the FMGEC.

The change-over from SPD to MACH mode is either automatically done by the FMGEC or manually by the pilots by pushing the SPD/MACH change-over P/B on the FCU.

THRUST MODE

In THRUST mode, autothrust commands a specific thrust level in conjunction with the AP/FD pitch mode. This thrust level is limited by the thrust lever position.

RETARD MODE

The RETARD mode is available only in automatic landing (AP engaged in LAND mode). In these conditions, the RETARD mode is engaged when the Radio Altitude (RA) becomes lower than 50 ft. If the AP is disengaged during flare-out before touchdown, the RETARD mode is replaced by the SPD/MACH mode. On ground this logic is not active and the RETARD mode is kept.

NOTE: In automatic landing, the Flight Warning Computer (FWC) auto call out delivers a RETARD message at 10 ft; the pilot moves the throttle control levers to the IDLE position and thus takes manual control of the thrust at landing. With the A/THR engaged but not in the automatic landing conditions, this message is delivered at 20 ft.

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A/THR in THRUST MODE	AP/FD PITCH MODE MAINTAINS THE SPEED : OP CLB - OP DES - CLB - SRS - FLARE and DES (IDLE path)
A/THR in SPEED/MACH MODE	IF NEITHER AP NOR FD IS ENGAGED
	IF AP/FD CONTROLS A VERTICAL PATH: V/S-FPA - ALT*- ALT CST* - ALT - ALT CRZ - G/S* G/S - FINAL and DES (geometric path)
A/THR in RETARD MODE	AUTOMATIC LANDING (AP ENGAGED in LAND MODE)

G9409341 - GAUT0T0 - FM22DE000000001

A/THR MODES - GENERAL ... RETARD MODE

FLIGHT MANAGEMENT GENERAL DESCRIPTION (3)

GENERAL

To help the pilots, the Flight Management (FM) functional part of the Flight Management Guidance and Envelope Computers (FMGECs) does several functions. These functions are linked to the flight plan such as lateral and vertical guidance, or display management. To achieve its objectives, the FM part is mainly based on:
- a navigation database and a performance database,
- lateral functions,
- vertical functions,
- performance functions.

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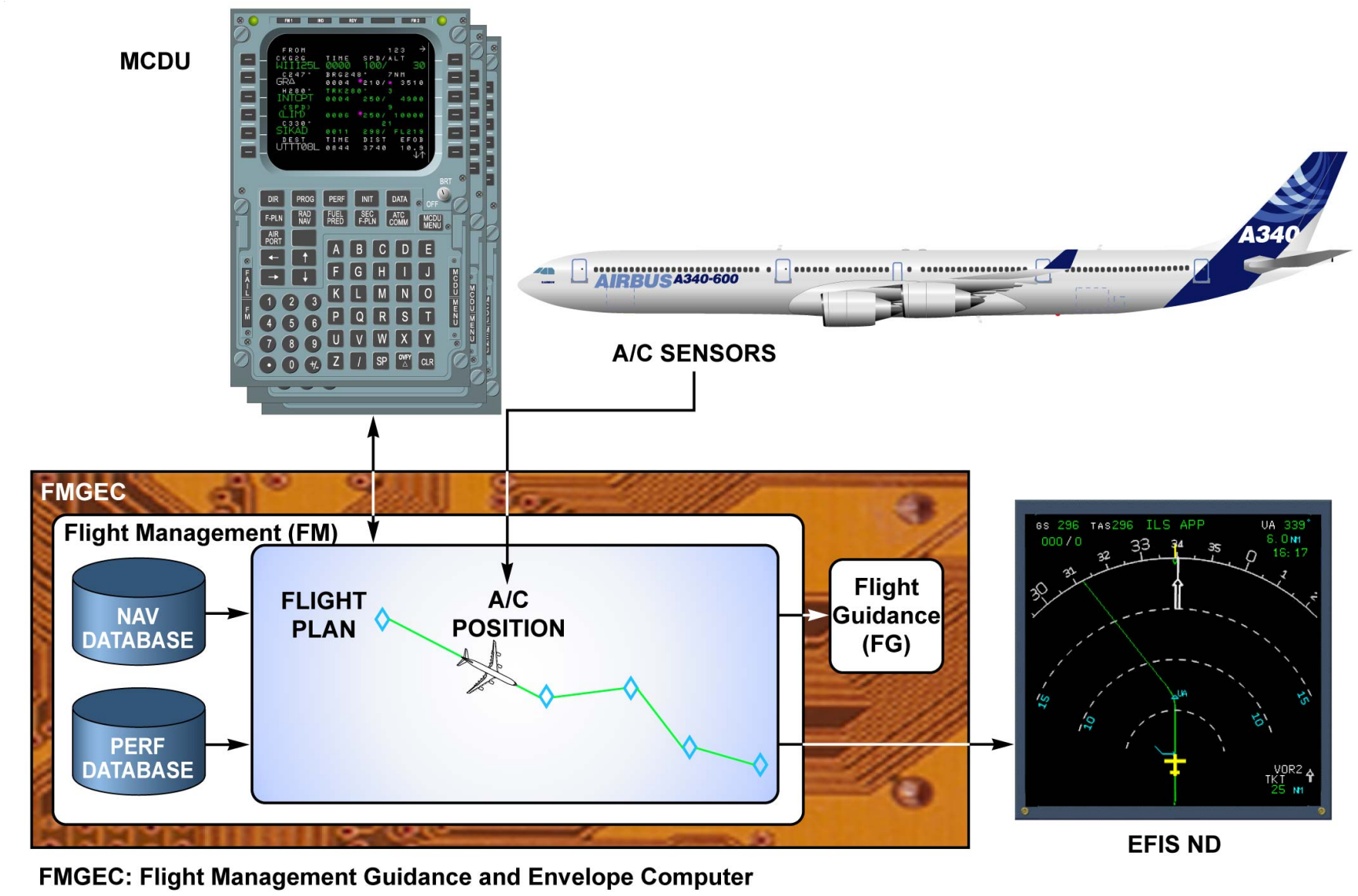

FMGEC: Flight Management Guidance and Envelope Computer

GENERAL

FLIGHT MANAGEMENT GENERAL DESCRIPTION (3)

FLIGHT PLAN

The FM part is used by the pilots to initialize, revise and monitor a flight plan through the MCDUs. In addition, the monitoring is also done through the Electronic Flight Instrument System (EFIS) NDs and PFDs. The FM part ensures flight plan tracking and optimization. The flight plan is divided into 2 parts: a lateral part and a vertical part. The lateral part gives the direction to follow while the vertical part gives the different altitude steps with related speed and time constraints. The FM part carries out the flight plan sequencing computation for both parts of the flight plan.

DATABASE

The database is a mass memory divided into 2 parts. The navigation database is used to assemble the lateral flight plan with waypoints, radio navigation aids and runways. The navigation database gives a worldwide coverage. Its content is updated every 28 days by the airline using a Multipurpose Disk Drive Unit (MDDU). A small space in the memory is kept for pilot entries to make new waypoints or radio navigation aids. The performance database, with aircraft aerodynamic and engine models, enables vertical flight plan construction and optimization. The performance database contains fixed data that can only be changed by the manufacturer.

LATERAL FUNCTIONS

The FM part, in relation with the navigation database and the MCDUs, carries out lateral functions. The lateral functions are:
- lateral flight plan selection and revision,
- initialization of the Inertial Reference System (IRS) and use of its data for the aircraft position computation (FM position),
- radio navigation aid selection and tuning (for VOR, DME, ADF, ILS),
- ND management for flight plan navigation related data including the aircraft position and its lateral deviation from the flight plan,
- computation of lateral steering orders to be followed by the Flight Guidance (FG) functional part.

VERTICAL FUNCTIONS

The FM part carries out vertical functions in accordance with the lateral flight plan and data either retrieved from the performance database or entered by the pilots through the MCDUs (for example cost index, Center of Gravity, weight). The vertical functions are:
- vertical flight plan construction according to altitude, speed and time constraints,
- ND and PFD management for guidance related data such as altitude constraints,
- computation of vertical steering orders and thrust demand to be followed by the FG functional part.

Note that, to allow the vertical guidance, the lateral guidance must already be active.

PERFORMANCE OPTIMIZATION

The FM part optimizes the flight plan in terms of speed, thrust, optimum and maximum altitudes. Predictions are given along the flight plan and used as a reference for the vertical guidance. This function minimizes the flight cost with the optimization of speed, fuel planning and time.

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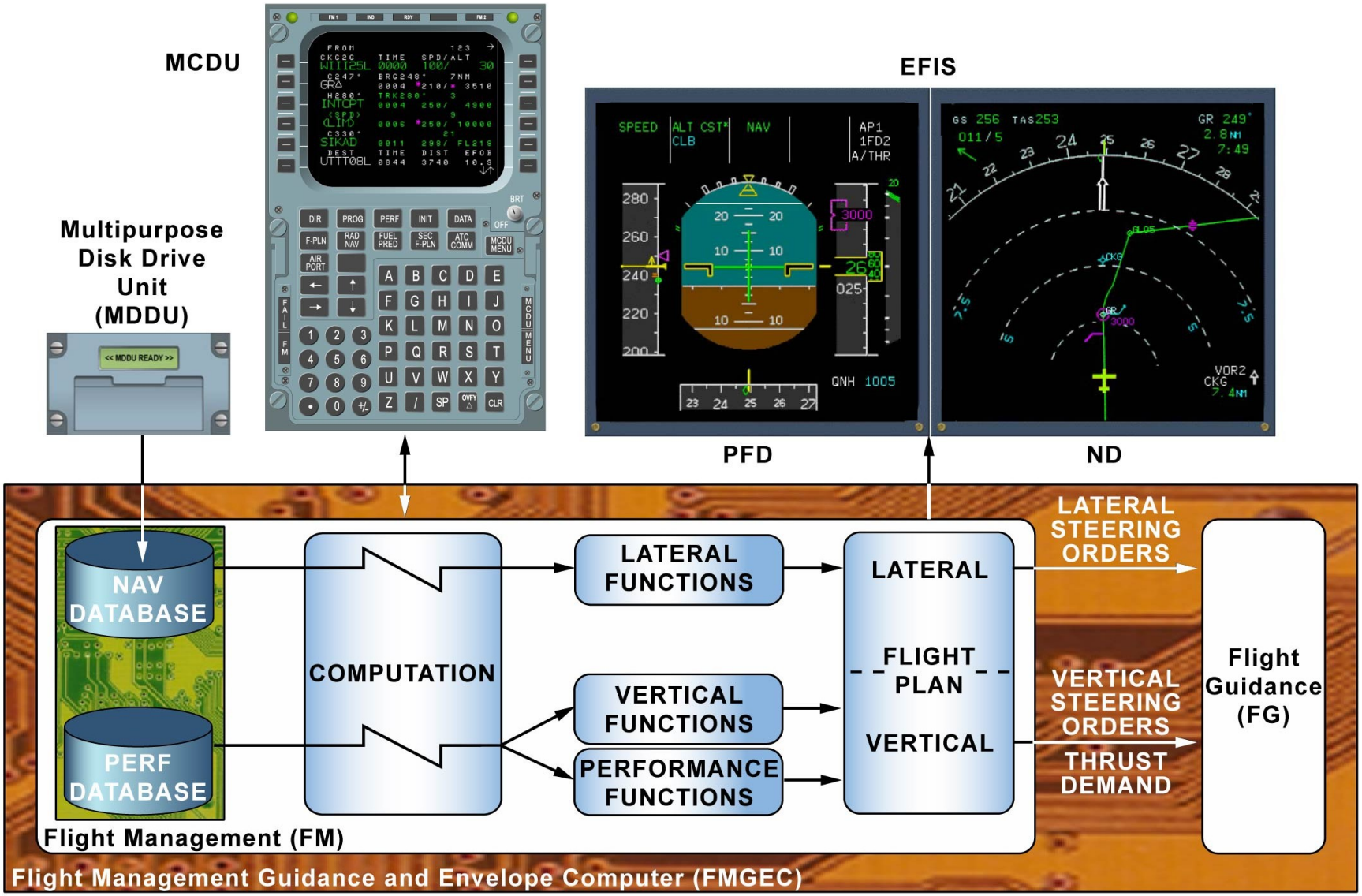

FLIGHT PLAN ... PERFORMANCE OPTIMIZATION

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FLIGHT PLANNING D/O (3)

FLIGHT PLAN

The flight plan is defined by various elements, which indicate the routes the A/C must follow with the limitations along these routes.
The elements are mainly taken from the databases or directly entered by the pilot. The limitations are mainly speed, altitude or time constraints originated by the ATC. The function that integrates these elements and limitations to construct a flight plan is called FLIGHT PLANNING. In addition to this, the Flight Management (FM) part provides the A/C position and the follow-up of the flight plan, this is called NAVIGATION. Everything can be prepared prior to take-off but can also be modified quickly and easily during the flight operation.
In case of an FM problem, the remaining valid Flight Management Guidance and Envelope Computer (FMGEC) can be used as the sole source to command both MCDUs and NDs after a manual action by the pilot on the FM SOURCE selector.

NAVIGATION DATABASE

The navigation database provides all necessary information for flight plan construction and follow-up. The pilot will either select an already assembled flight plan (company route (CO ROUTE)), or will build his own flight plan, using the existing database contents. This database has a worldwide coverage, updated every 28 days. A crossloading facility is available allowing the database loading from either FMGEC database through an intersystem bus. Besides this, some room is kept to allow manual entry of 20 navaids, 20 waypoints, 5 routes and 10 runways.
The database cannot be erased, except for the manually entered data.
Two cycle databases can be inserted, the selection is made automatically using data from the A/C clock.

NAVIGATION

The navigation process provides the system with current A/C state information consisting of present position, altitude, winds, true airspeed and ground speed. This is achieved using inputs from the Inertial Reference System (IRS), Air Data System (ADS), navigation radios and, Air Traffic Service Unit (ATSU). Position can be updated manually during the flight or automatically e.g.: on the runway threshold at take-off.

LATERAL FLIGHT PLAN

The lateral flight plan provides the sequential track changes at each waypoint within 3 main sections. DEPARTURE: In this phase the lateral flight plan provides initial FIX (origin airport), SID (Standard Instrument Departure), etc. EN ROUTE: In this phase the lateral flight plan provides waypoints, navigation aids, etc. ARRIVAL: In this phase the lateral flight plan provides STAR (Standard Terminal Arrival Route), approach, missed approach, go around, etc.
The lateral steering order can be followed by the pilot or the autopilot through the NAV mode selected on the Flight Control Unit (FCU).
In case of loss of both FM processors, a simplified FM function is available directly from MCDU1 or MCDU2 only. This is called BACK-UP NAVIGATION function. The following features are provided :
- lateral flight planning,
- A/C position,
- flight plan with crosstrack error (XTRKE).

In this case, there is no Autopilot coupling in NAV mode.

VERTICAL FLIGHT PLAN

The vertical flight plan provides an accurate flight path prediction, which requires a precise knowledge of current and forecast wind, temperature

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and the lateral flight path to be flown. The vertical flight plan is divided into several flight phases:
- the PREFLIGHT phase in which the vertical flight plan provides fuel, weight and V2 insertions,
- the TAKE-OFF phase in which the vertical flight plan provides speed management, thrust reduction, altitude and acceleration altitude,
- the CLIMB phase in which the vertical flight plan provides speed limit and speed management,
- the CRUISE phase in which the vertical flight plan provides top of climb, cruise altitude and top of descent,
- the DESCENT phase in which the vertical flight plan provides speed management and deceleration,
- the APPROACH/MISSED APPROACH/GO AROUND phase in which the vertical flight plan provides thrust/acceleration altitudes.

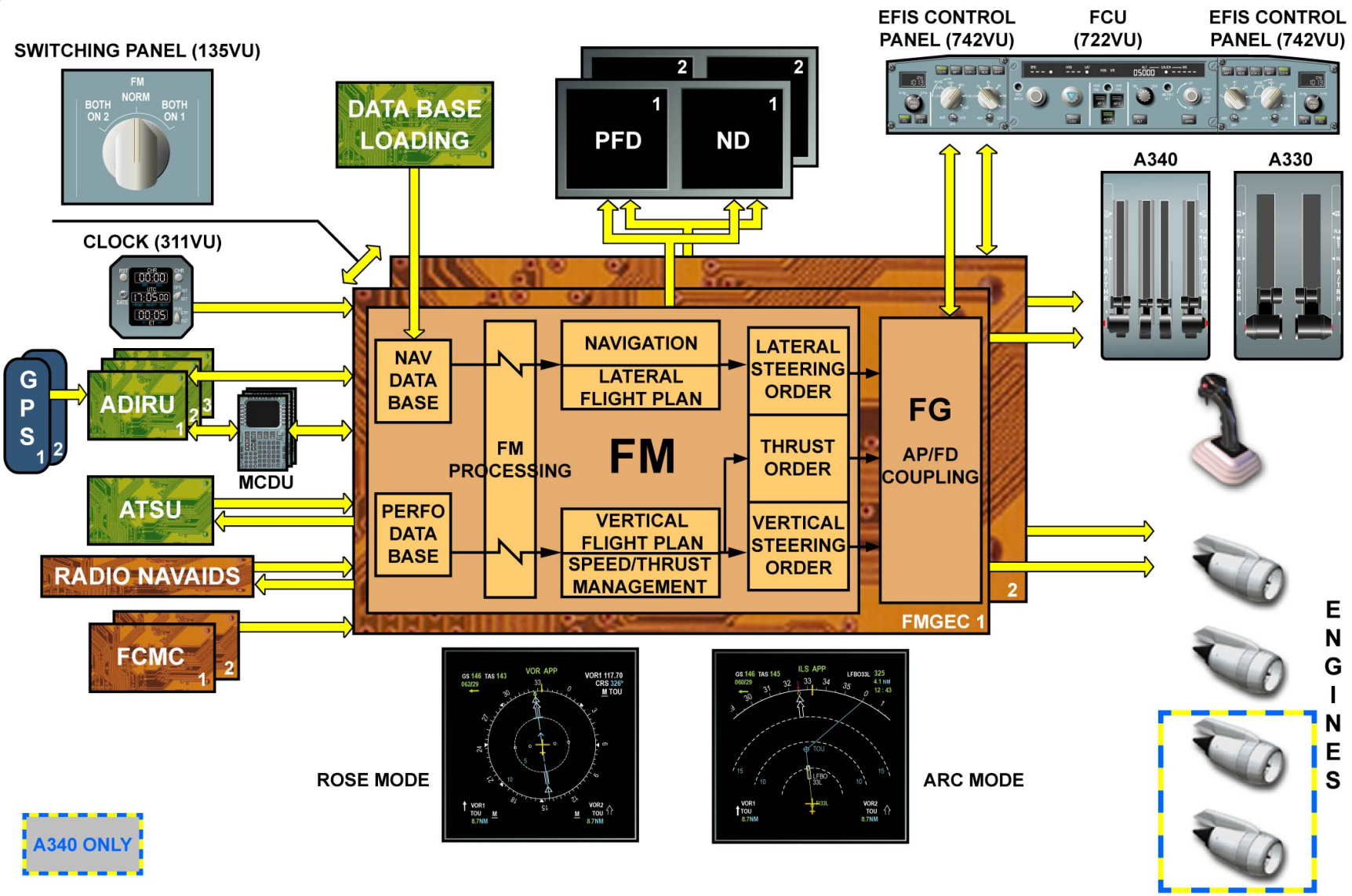
The vertical steering order can be followed by the pilot or the autopilot. Any level change in the vertical profile is initiated after a push action on a level change selector. The crew may send a request for wind data to the ground via the ATSU. In response to this request, or automatically, the ground sends climb, cruise, descent and alternate wind data to the A/C.

PERFORMANCE

The performance database contains optimal speed schedules for the expected range of operating conditions. Several performance modes are available to the operator with the primary one being the ECONOMY mode. The ECON mode can be tailored to meet specific airline requirements using a selectable COST INDEX (CI). A CI is defined as the ratio of cost of time to the cost of fuel. The fuel quantity is given by the Fuel Control and Monitoring Computers (FCMCs). The speed and the thrust values associated with a given CI are used to determine the climb and descent profiles. FUEL and TIME are the main "actors" in this particular part of the FM function and direct the airline choice.

DISPLAY

According to the pilot selection on the FCU, the flight plan is shown in relation to the A/C position on the ROSE-NAV or ARC modes. The A/C model is fixed and the chart moves. The difference between the two modes is that the half range is available when the ND is set to NAV mode as there is only a frontal view when it is set to ARC mode. In PLAN mode, the flight plan is shown, with NORTH at the top of the screen, centered on the TO waypoint (first waypoint to be met).
Depending on the selected range, the A/C may or may not be visualized on this display. The PLAN display can be centered on the waypoint displayed on the second line of the MCDU screen by scrolling the flight plan on the MCDU. The PFD shows the FM guidance following engagement of the AP/FD (Autopilot/Flight Director) lateral and longitudinal modes.



FLIGHT PLAN ... DISPLAY

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FLIGHT MANAGEMENT PRIORITY LOGIC D/O (3)

FM OPERATING MODES

There are three operating modes: NORMAL, INDEPENDENT and SINGLE. At Flight Management (FM) initialization, that means at power-up, both FM parts exchange information. Initial cross-comparison is made on the following parameters: Navigation data base, performance data base and soft program serial numbers, A/C, engine type and program pin.
If the FM parts agree, NORMAL mode is active. When keys are pressed, they are immediately processed by both FMs, regardless of the MCDU from which they originate.
If the FM parts disagree, INDEPENDENT mode is active. Each FM part manages its own MCDU.
If one FM part has failed, SINGLE mode is active. Both MCDUs are driven by the remaining FM part.
Note: an FM failure or an independent configuration is indicated by the lighting of the corresponding legend "FM1", "FM2", "IND" on the top of the MCDUs.

MODE OPERATION

In NORMAL mode, the FM part receives the master/slave activation from the Flight Guidance (FG) part. The MASTER computer imposes the following parameters upon the SLAVE computer: Flight phase, flight plan sequencing, active performance mode and speeds, clearance and maximum altitudes and ILS frequencies and courses, if any.
After a flight plan change, there is a comparison on the active leg and, every second, on the active performance mode and active guidance mode. If it is different, the slave computer will synchronize itself to the master one by copying the master values.
Also, A/C position, Gross Weight (GW) and target speeds from master and slave computers are compared every second. If the difference is greater than 5 Nm, 2 tons or 2 Kts respectively, an appropriate message is displayed on the MCDUs: - FMS1/FMS2 POS DIFF, FMS1/FMS2 GW DIFF, FMS1/FMS2 SPD TGT DIFF. Pilot action is then required.
In INDEPENDENT mode, there is no interaction from one system to the other one. The Flight Management Guidance and Envelope Computers (FMGECs) only send their status information to each other (e.g., in this case, the INDEPENDENT mode).
In SINGLE mode, both MCDUs are driven by the same FM part, but they can still display different pages. Messages linked to the navigation process are displayed on both MCDUs.

MCDU

As already presented in the FM OPERATING MODES topic, the MCDUs work differently. In NORMAL mode, the MCDUs can be used simultaneously on different pages. Any modification or entry on one MCDU is transmitted to the other MCDU via the FMGEC crosstalk.
In INDEPENDENT mode, both MCDUs operate separately. The "IND" light, at the top of the MCDUs, indicates this operation.
In SINGLE mode, both MCDUs basically work as in normal mode, but with only the valid FMGEC. The "FM1" or "FM2" lights, at the top of the MCDUs, indicate the FM1 or FM2 failures.

DISPLAYS

FM information is displayed on NDs and on PFDs. For FM information, in NORMAL or INDEPENDENT modes, FMGEC1 supplies PFD1 and ND1, and FMGEC2 supplies PFD2 and ND2.
In SINGLE mode, the remaining FMGEC supplies all the displays.

RADIO NAVIGATION

The schematic shows the architecture of the radio navigation receivers controlled by the FMGECs in NORMAL or INDEPENDENT modes.
For the selection of radio navigation frequencies and courses, in normal or independent modes, each FMGEC controls its own side receivers

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through a Radio Management Panel (RMP). Only the actual frequencies and courses from the receivers are displayed on the PFDs and the NDs.
In case of a FMGEC failure, the valid FMGEC controls its own side receivers as usual, through an RMP, but also the other side receivers, directly without going through an RMP. The pilot must first transfer both FMs to the same source as you can see in topic "FM SWITCHING".
If both FMGECs fail, the crew must use the RMPs to select the frequencies and courses.

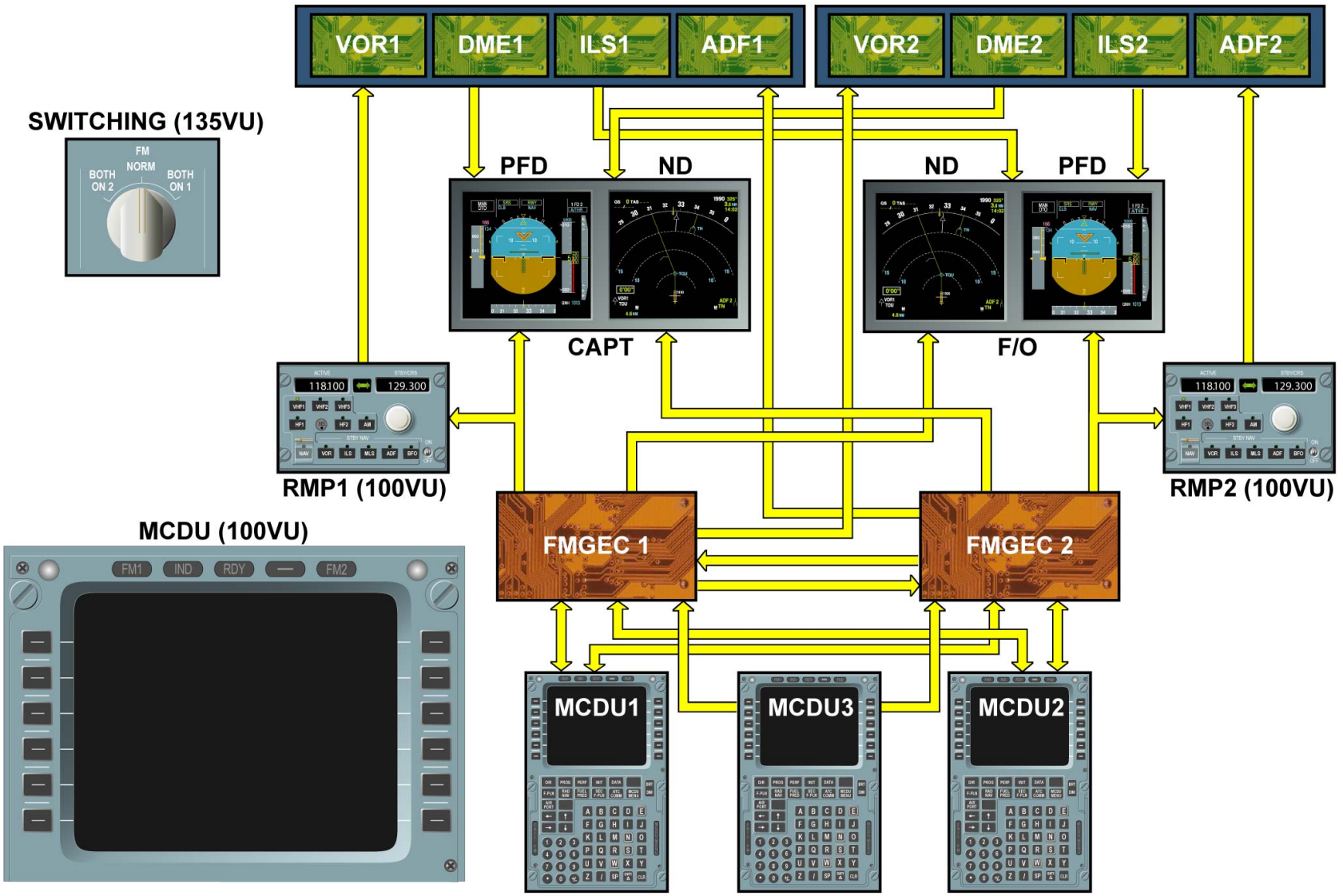
FM SWITCHING

Laid out on the pedestal switching panel, there is a manually operated switch called "FM SOURCE". It has 3 positions : NORM, BOTH ON 1 and BOTH ON 2.
Setting the switch to "NORM" position, assuming no MCDU has failed, will validate the normal configuration: MCDU1 works with FM1 and MCDU2 works with FM2.
Setting the switch to BOTH ON 1, enables MCDU1 and MCDU2 to work with the same FM1 source. This also makes the two operative Display Management Computers (DMCs), feeding the EFIS displays, work with the same FM1 source. Setting the switch to BOTH ON 1 will also enable the navaids to be tuned from the same FM1 source.
Setting the switch to BOTH ON 2, enables MCDU1 and MCDU2 to work with the same FM2 source. This also makes the two operative DMCs feeding the two EFIS displays work with the same FM2 source. Setting the switch to BOTH ON 2 will also enable the navaids to be tuned from the same FM2 source.
Note that all the above also applies to MCDU3 when it replaces MCDU1 or 2 switching operation (in case of failure of MCDU1 or 2).
If FM1 has failed, MCDU1 can be switched manually through the "FM SOURCE" selector switch. MCDU1 is switched to work in full capability with FM2, and this, without disturbing the link between FMGEC2 and MCDU2. If FM2 has failed, the same applies but with MCDU2.
As an alternative way and provided the switch is in the "NORM" position, the Back-up Nav function of MCDU1 or 2 can be activated through a specific prompt on the MCDU MENU page, to cover failure of FM1 or 2.

MCDU SWITCHING

Turning the brightness knob of one MCDU to "OFF" permits the MCDU switching. This knob is located on each MCDU front panel.
The way to proceed is the following:
- turning the brightness knob of MCDU1 to "OFF", controls the transfer from MCDU1 (which is blank and inoperative) to MCDU3 of the FM function (normally FM1). If the BRT knob is in the OFF position, the RDY annunciator is lit to indicate the good result of the power-up test.
- turning the brightness knob of MCDU3 to "OFF", makes MCDU3 inoperative and transfer is no longer possible. Note that if both MCDU1 and 2 are turned OFF, the transfer from MCDU1 to MCDU3 will have priority over the one from MCDU2.

If MCDU1 or MCDU2 has failed, MCDU3 must be able to work with FMGEC1 or FMGEC2 in order to replace MCDU1 or MCDU2 for the Flight Management function.
For a dual MCDU1 and 2 failure, MCDU3 has to operate like MCDU1. This reconfiguration does not include the Back-up Nav function, which remains selectable on MCDU1 or 2 only, and not on MCDU3.



FM OPERATING MODES ... MCDU SWITCHING

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NAVIGATION BACK-UP D/O (3)

GENERAL

The MCDU BACK-UP NAV (B/UP NAV) must be used as a back-up system when both Flight Management (FM) parts are failed, supplying the crew with limited information, which can be used to complete the current flight.
The MCDU B/UP NAV is activated through the "SELECT NAV B/UP" prompt on the MCDU MENU page. This prompt is available at all times, regardless of the status of FM1 or FM2, provided the FM SOURCE selector is set to the NORM position.
If the FM source selector is moved from the NORM position to one of the other two positions, BACK-UP NAV is deactivated. Finally, there is no interconnection between MCDU1 and MCDU2, so the B/UP NAV functions work independently and may be activated separately.

NOTE: Note that MCDU3 does not have this option, even when it is used to replace MCDU1 or MCDU2.

FLIGHT PLANNING

Before activation of the BACK-UP NAV function, a condensed form of the flight plan is transferred from the FM part to the MCDU. This downloading is updated in case of:
- FM primary F-PLN changes,
- FM lateral leg sequencing,
- FM long power off,
- FM source selector change,
- FM resynchronization.

Downloading includes waypoint position, waypoint identifier, leg type, discontinuity, overfly and turn direction information in a maximum of 150 legs.
At BACK-UP NAV activation, a last updating is performed and then any other updating is ignored. A reduced capability is given to the MCDU B/UP NAV function compared to the FM function.

NAVIGATION

The BACK-UP NAV function is based on Inertial Reference (IR) inputs from the ownside IR or IR3 which provide position, ground speed, track, heading, altitude and wind. The selected IR depends on pilot selection, through the IR source selector, to be consistent with the current displayed IR data on the corresponding PFD and ND. The MCDU B/UP NAV provides, the crosstrack error and the bearing/distance/time to go to the active waypoint, depending on the aircraft latitude/longitude and on the active leg of the flight plan. It supplies the automatic leg change when the TO waypoint is reached.
It is very important to note that all this data is only for display, there is no steering order issued by the MCDU, and the NAV mode cannot be engaged.

ND DISPLAY

The MCDU transmits the BACK-UP F-PLN to the NDs. It consists of active F-PLN vectors and waypoints related to the fixed aircraft position in ROSE or ARC modes, or to the moving aircraft reference in PLAN mode. In all cases, the flight plan line is dashed in green (as NAV mode cannot be engaged). Options selectable on the EFIS control panel are not allowed (WayPoinT, AiRPorT, VOR.D, Non-Directional Beacon, ConSTRaint).

MCDU PAGE AVAILABILITY

All flight planning operations are directly applied through the B/UP F-PLN page. It displays each leg of the active route, providing position information for each waypoint, as well as computed course, time and distance for the connecting legs. The revisions, available on the B/UP F-PLN page, are:
- waypoint insertion,
- waypoint deletion,

- discontinuity deletion,
- overfly deletion/insertion.

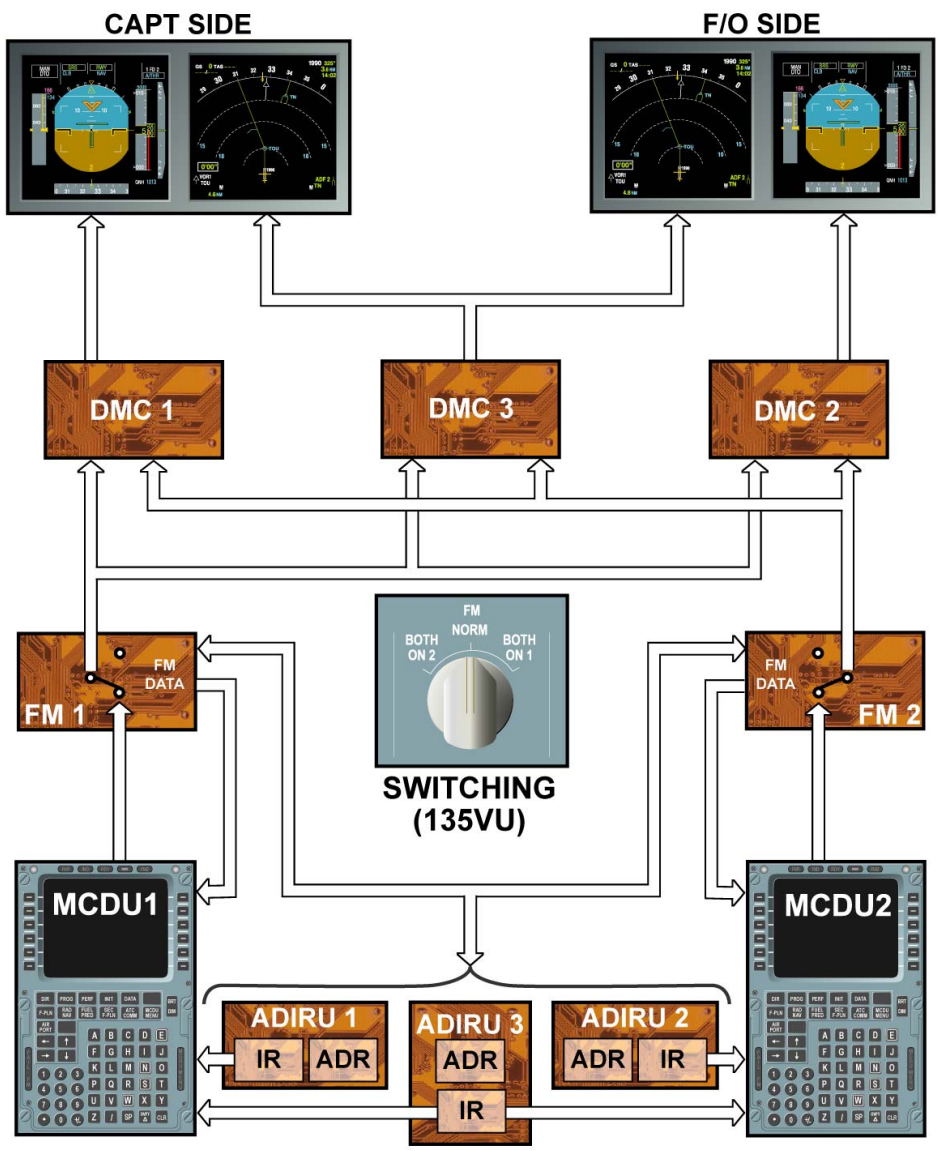
Pressing the DIR key enables the selection of a waypoint to join it directly. The B/UP F-PLN/DIR TO page is similar to the F-PLN page but line 1 is reserved for waypoint entry.

Pressing the PROGress key gives navigation information. The B/UP PROG page displays the aircraft position with identification of the selected IR. It also provides ground speed, active leg track with aircraft track. The top line displays the waypoint identifier and altitude at the last sequenced waypoint, also called overhead (OVHD).

The bottom line enables access to the B/UP IRS pages. The B/UP IRS pages correspond to IR1 or 2, function of MCDU1 or 2, and IR3. IR provides, for display information about position, the true track, the true and magnetic headings, the ground speed and the wind.

DEACTIVATION

When the BACK-UP NAV function is voluntarily left, the return is performed on the MCDU MENU page. DESELECT NAVB/UP prompt must be pressed to return to normal operation.



ND

GENERAL ... DEACTIVATION

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POWER INTERRUPTIONS AND POWER UP TESTS D/O (3)

INTERRUPTION < 10 MS

For the Flight Management Guidance and Envelope Computer (FMGEC), Flight Control Unit (FCU) or MCDU, the transparency time may be around 10 ms and these interruptions do not affect the system. The only effect is on the MCDU Cathode Ray Tube (CRT) which will momentarily flash.

10 MS < INTERRUPTION < 200 MS

If interruption is between 10 ms and 200 ms, the cut-off is a short power fail. The FMGEC/FCU/MCDU are recovered after the power interruption. In particular the data displayed on the MCDU and the FCU and the output bus data for all the equipment are recovered after a short power fail without pilot action.

200 MS < INTERRUPTION < 5 Sec

When the interruption is between 200 ms and 5 sec, the cut-off is a long power fail. A complete initialization of the system is performed, indicating that a long power fail occurred. The protection of data stored in the RAMs cannot be longer than 500 ms, except for the FM RAM which is supplied by a 5 V back-up battery (for the FM part, the system status prior to the interruption is stored).

INTERRUPTION > 5 Sec

When interruption is longer than 5 seconds the type of cut-off is a very long power fail. This leads to an automatic reset where, as long as the reset command is held, the computer behaves as not powered or not active. This also leads to safety tests on ground.

NOTE: Note that the FCU retrieves any selected data after an interruption of 5 minutes or less and due to the 5 V back-up battery, the FM retrieves the flight plan data for display on the MCDU whatever the interruption time.

POWER-UP TEST

Power-up tests are performed when the A/C is on the ground, following a power cut longer than 5 seconds. The duration of the tests does not exceed 40 seconds in normal cases. The power-up tests carry out an interface test and an analysis (sent to the Central Maintenance System (CMS)).

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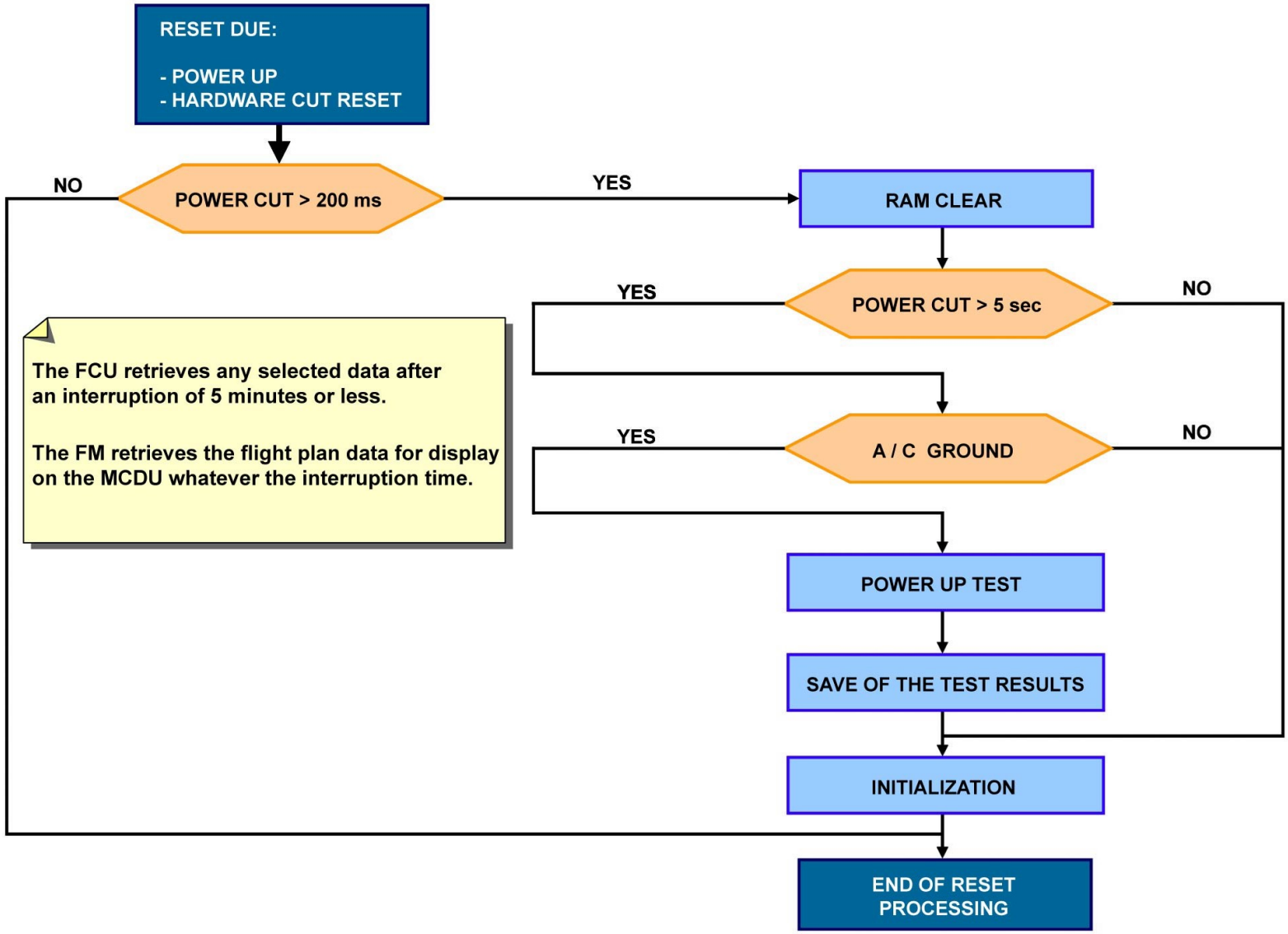


INTERRUPTION < 10 MS ... POWER-UP TEST

POWER INTERRUPTIONS AND POWER UP TESTS D/O (3)

FM POWER-UP TEST

Following a reset or a transient reset greater than the transparency time of 10 ms, the FM part executes specific internal tests called power-up test. It verifies minimum FM hardware integrity and proper initialization. The total execution time of this test is less than 2 seconds.

FCU POWER-UP TEST

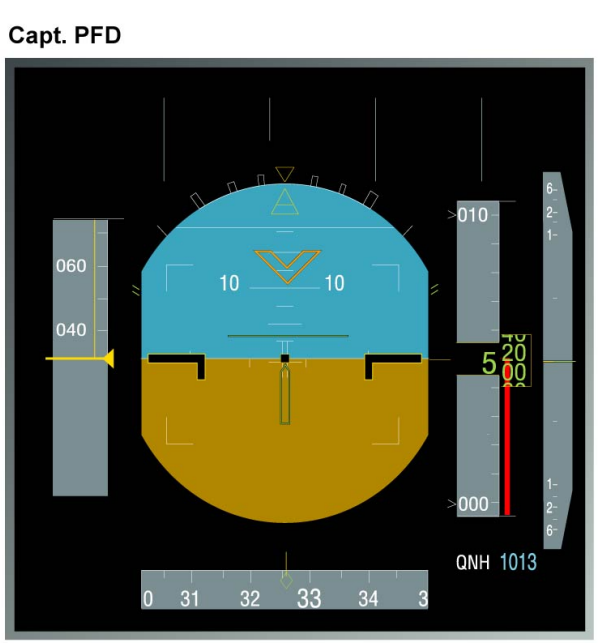
The FCU power-up test has to be performed to confirm system availability and is initiated automatically on the channels concerned (B/power supply 1, C/power supply 2) when the following conditions are met:
- Aircraft On Ground,
- restoration of electrical power after a power cut-off longer than 5 seconds.

The duration of this test is approximately 90 s.

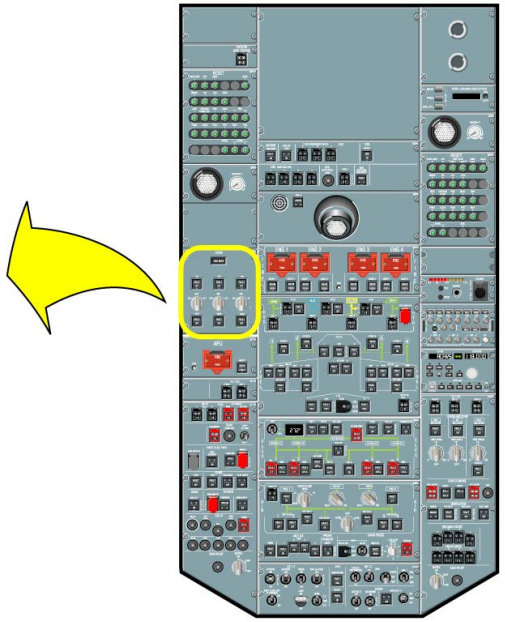
NOTE: Note that at this moment, the Flight Director (FD) P/B lights come on but the FD function is not yet available.

On initialization, the FCU returns to a neutral configuration. The flashing of AP1, AP2 and A/THR P/Bs proves the success of the internal tests. The FD is finally engaged and the FD red flag removed from the PFDs when the Inertial Reference (IR) system providing the position has been correctly initialized with a delay of 10 minutes and when the present position is entered.
FD status is indicated on the Flight Mode Annunciator (FMA). The altitude, by default 100 feet, is displayed on the FCU. The altitude mode is automatically armed and displayed on the FMA.

NOTE: If FCU fails, FMA data on PFDs are lost and on the Enhanced GPWS panel FAULT light comes on on the SYStem P/B, due to the loss of the QNH barometric reference.



(221VU)



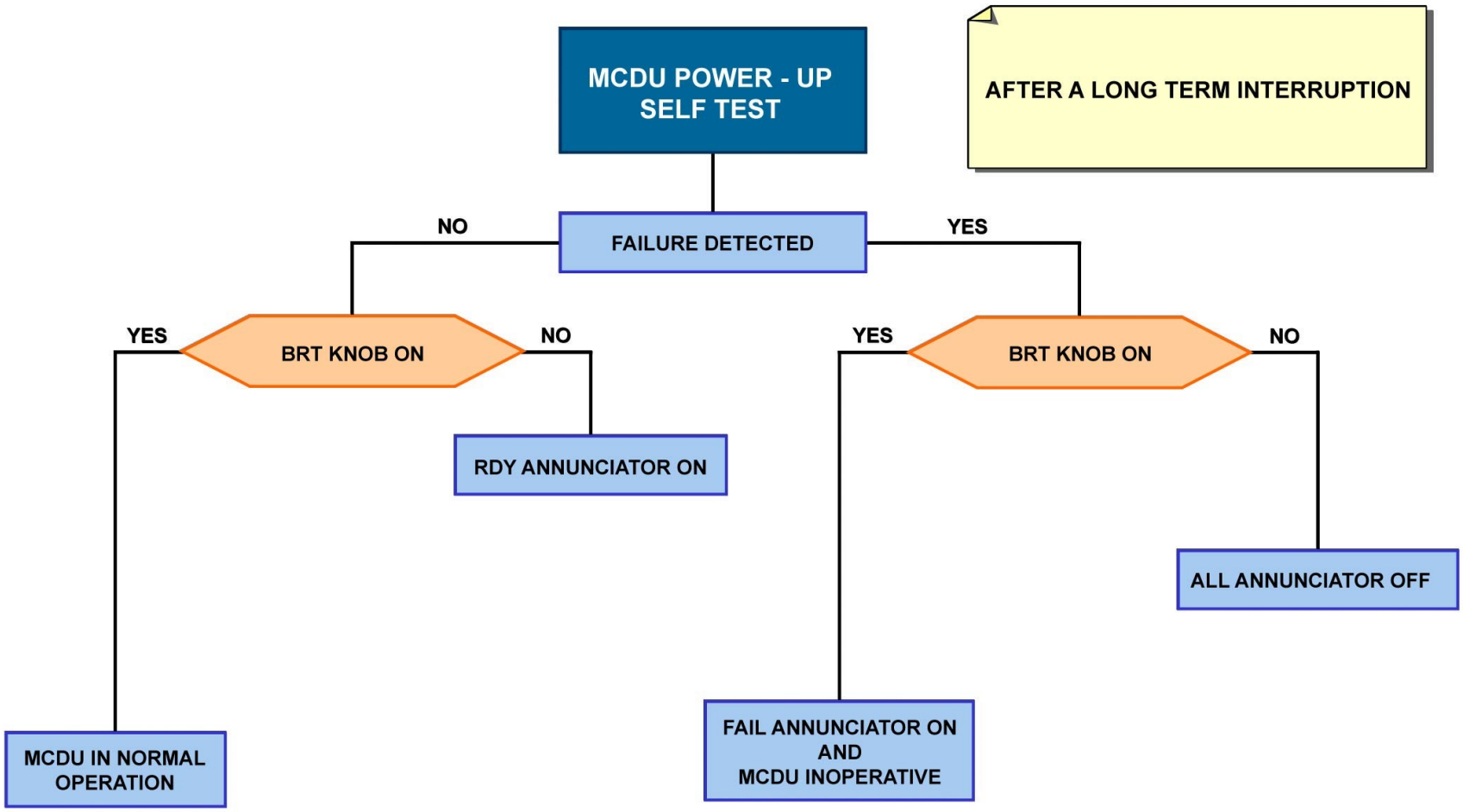
LEFT ECP (742VU) | FCU (722VU) | RIGHT ECP (742VU)

FM POWER-UP TEST & FCU POWER-UP TEST

POWER INTERRUPTIONS AND POWER UP TESTS D/O (3)

MCDU POWER-UP TEST

After a long-term interruption or the movement of the brightness knob from the ON to OFF position, the MCDU extinguishes all annunciators and performs its power-up self test.



MCDU POWER-UP TEST

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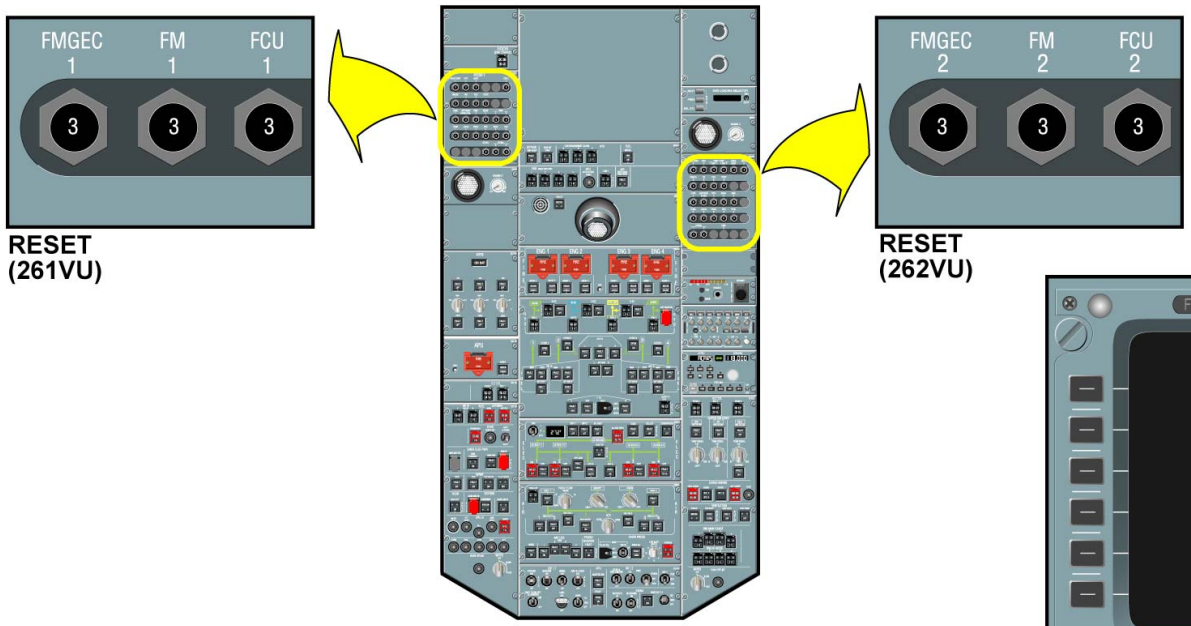
POWER INTERRUPTIONS AND POWER UP TESTS D/O (3)

MANUAL RESETS

The reset function is available in the cockpit on the overhead panel. The FM reset SW resets only the FM part. The FMGEC reset SW resets all the FG, FE and FM parts.
Safety test will be run if the aircraft is on ground with engines stopped. In flight, the FM or FMGEC reset SW reset leads to the disconnection of the ownside autopilot (if it was engaged) with the resynchronization of both FMs. The MCDUs are reset by the brightness knob (ON/OFF).
A complete FCU reset is performed by pulling the FCU reset SW longer than 5 min.
The RESET is activated by sending a ground signal to the computer or the function. When the RESET state is confirmed and as long as the RESET command is held, the computer behaves as not powered or not active. The operational functioning of the computer is active when the control signal is back to the NO RESET state.



Safety test will be run if aircraft is on ground and engines stopped.

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MANUAL RESETS

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